Engineering News

Vol. 68, No. 21 505 Pearl Street, New York November 21, 1912

Extracts from the Annual Report of the Isthmian Canal Commission

CONSTRUCTION AND ENGINEERING
FIRST DIVISION

The first division of the office of the chief engineer, under Col. H. F. Hodges, U. S. A., assistant chief engineer, continued in charge of the design of the locks, dams, regulating works, and accessories; the design and construction of aids to navigation: the inspection of the manufacture and erection, under contract or otherwise, of the lock gates, operating machinery, gates and valves, emergency dams and fender chains, and of the placing of such concrete in the locks as was omitted until the installation of the machinery.

TESTS OF VALVES FOR THE LOCKS—To determine the probable leakage around the rising stem valves, also the force required to start the valve and to maintain the motion, a test was made on a set of two valves which were installed in the upper valve chamber of the west-side culvert at Gatun. The entrance to the culvert was closed by a water-tight bulkhead, and the culvert between the bulkhead and the valves, with the well above the valves to the top of the wall, was filled with water. By this arrangement there was a greater head against the valves than will obtain when the lock is pumped dry for examination, and considerably greater than the usual operating head.

Under a 79-ft. head that resulted, the combined leakage of both valves was 1.82 cu.ft. per sec., while the combined friction resulting from the contact of the side seals of the gate, as well as the action of the roller trains, averaged 21,170 lb. for each valve. It had been assumed at 31,750 lb. in the design of the machinery, which was intended to exert a lifting force of 60,000 lb., including all friction and the weight of the valve and its accessories. It is probable that both the friction and the leakage will be reduced in subsequent valves, as certain improvements in detail and workmanship are found in those of later construction.

One of the cylindrical valves in the locks at Gatun was tested for leakage from the exterior by constructing a bulkhead across the entrance to the valve chamber, which was then filled with water. When the head reached 60 ft. the leakage was found to vary from a quantity too small to measure to about 0.25 cu.ft. per sec. The average was about what was to be expected from the tests made at Pedro Miguel and described in the last annual report.

TESTS OF ELECTRIC MOTOR INSULATION—Owing to the peculiar climatic conditions on the Isthmus, involving tropical heat and extreme humidity, and the deteriorating effect of these conditions on the insulation of electrical machinery, it was necessary to investigate thoroughly the different kinds of insulation available for use on the lock machinery.

To accomplish this, 16 sample motors in all were purchased, two from each company offering bids for the motors required. Eight of these were sent to the machine contractors for operating tests on the valve machines, and the other eight were shipped direct to the Isthmus, where they were subjected to the extreme conditions specified in the specifications accompanying the invitation for bids, in order to test the insulation.

They were first placed in a storehouse at Gatun and exposed to the ordinary conditions of climate for a period of about two months, during which time the condition of the insulation was determined periodically by inspection and tests. In order to expedite the action of the heat and humidity they were subjected to a steam test, in which the extremes of temperature and humidity mentioned might be reproduced. In order that the conditions of all motors might be identical in all respects, the motors were placed in a small building erected for the purpose and the tests performed on all motors simultaneously, so that the motors were subjected to the same humidity and temperature for the same length of time.

Briefly, the tests consisted of filling the building in which the motors were located with steam, thereby maintaining a temperature of 50° C. for a period of 10 days, making potential tests and measurements of insulation throughout this period. In addition to the steam test, the motors which survived were immersed by filling the case with water at a temperature of approximately 30° C. and maintaining this condition for about 5 hr.,

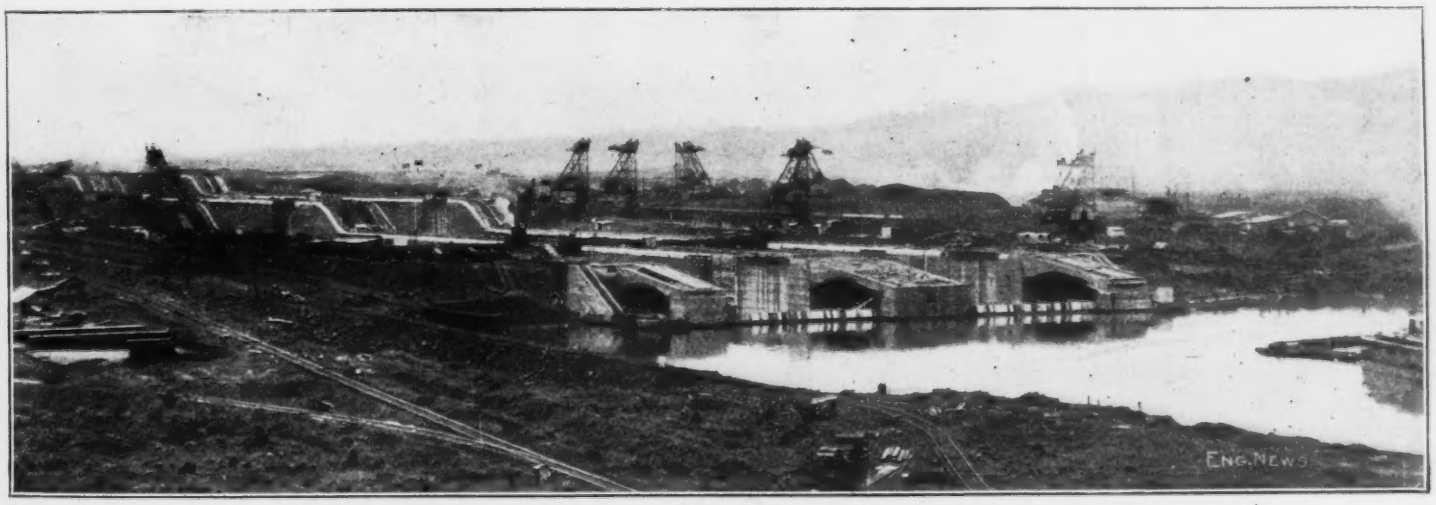


FIG. 1. GENERAL VIEW OF FLIGHT OF LOCKS AT GATUN, JUNE, 1912
(Temporary coffer-dam is seen in place at north end of lower lock chambers)

during which time observations of insulation resistance were made continuously. The eight motors which were first shipped to the machine contractors were, after reaching the Isthmus, subjected to the immersion test but not the steam test. The tests were conducted without the presence of any representative of the manufacturers.

The relative standing of the various types of insulation in these tests was, in general, definite and the choice of the most suitable insulation was clear; however, in view of the number of motors tested, it was desirable to obtain a numerical basis of comparison. A schedule of the various stages of the tests was, therefore, prepared and a number of points assigned for the survival of each of these stages. The motors were given four points for surviving the test; three if, after failure during the test, the insulation recovered without repair; two if, after such failure, the insulation was found possible of repair; one if, after repair, the motor recovered; and none if they failed to recover at all. The total points for each of the four motors representing the manufacturer in the entire series of tests then served as an index from which the relative value of the insulation could be determined. The contract was awarded on the basis of the tests as above outlined.

PROGRESS ON THE LOCK GATES—The lock gates are being constructed and erected under contract dated June 21, 1910. The total steel plates and shapes accepted at the mills to the end of the fiscal year aggregated about 52,322 tons, which practically comprised all the rolled material required, excepting that for the spare parts. About three-quarters of all the castings were made, machined, and accepted. The only change in the material for any part of the gates was made in the bushings for the pintles at the bottom of certain leaves that will always be in sea water. In order to avoid possible damage through electrolytic action, these bushings will be made of hard-cast vanadium steel instead of the manganese bronze used in the other gates. Certain of the other leaves which will be operated in brackish water are to be protected from erosion by the use of zinc rings placed close to the bronze bushings.

The total shipment of structural material to the end of the fiscal year 1912 aggregated about 39,000 tons, or 76% of the amount required for all the gates. Of the above total, about 32,000 tons were shipped during the fiscal year, so that on June 30, 1912, a total of 13,000 tons remained to be forwarded, comprising about half the material for the gates in the intermediate locks at Gatun and the upper locks at Miraflores and all the material for the gates in the lower lock at Miraflores. At this rate of progress the steel work for all the lock gates and the spare parts provided for in the contract will be completed in the shops before Nov. 1, 1912.

On June 30, 1912, the work of erecting the gates on the Isthmus was in progress on 23 gates, or exactly half of the total number on the canal, but these gates were in various stages, and none of them was entirely completed. They comprised all the gates in the upper lock and the intermediate gates in the lower lock at Gatun and all the gates at Pedro Miguel excepting the lower guard gate in the west chamber. No material was placed at Miraflores. The total steel in place in the several gates at the end of the fiscal year amounted to 19,631 tons, or about 34%. With the exception of 412 tons previously reported, all of this material was erected during the fiscal year. The total number of field rivets driven to June 30, 1912—practically all of them during the fiscal year—was 963,500 out of 5,750,000, or only 17% of the total.

The completion of the several gates has fallen considerably behind the dates specified in the contract, due in part to the failure of the contractors to deliver the necessary material and tools on time, and in part to the limited number—and in some cases to the poor quality—of mechanics and laborers. This has been the case especially in the field riveting and the machine work necessary for the erection of the gates. A close and continuous inspection was maintained, and it is believed that the completed gates will meet fully the standard laid down in the specifications. The tests for watertightness made in the first gate at Gatun indicate excellent workmanship in this respect.

TESTS OF GATE OPERATION—Contracts were entered into toward the end of the previous fiscal year for the first two miter gate-moving machines and for the first miter forcing machine. The miter gate-moving machines were installed in their respective places, and one tested in regular service of swinging a gate in the dry. The operation was successfully performed in 1 min. and 48 sec., or 12 sec. less than the estimated time. As the tests were satisfactory, the contract for the remaining 90 miter gate-moving machines was made on Feb. 11, 1912.

TOWING MACHINERY—The electric-towing locomotives were described in the annual report of 1910. Bids for these machines were invited, and the same policy was followed as in the case of other machines of asking the price for one and also on the remainder if the sample proves satisfactory. A contract was entered into for the delivery of one locomotive complete, with the option of purchasing the other 39 that will be required. Under the contracts for materials in connection with the locomotive track, 95% of the structural parts was completed during the year.

ELECTRIC POWER STATION—Specifications were issued Sept. 9, 1911, covering the main generating equipment for a hydroelectric station, containing three 2000-kw. units, to be located adjacent to the spillway in Gatun Dam. The equipment is to consist of three 2250-kw. water turbines, three head gates, three penstocks, three governors, three draft tubes, three 2000-kw. generators, three direct-connected 50-kw. exciters, two 100-kw. motor-driven exciter sets, one 30-ton electric crane, and one lubricating system.

The average head throughout the year will be approximately 75 ft., the elevation of the tail race being about 8 ft. above sea level. During the dry season it will be necessary to draw upon the storage in Gatun Lake. The maximum quantity of water diverted for hydroelectric development is approximately 7% of the minimum water supply and is the excess which is not required for lockages, evaporation and leakage.

LIGHTING THE LOCKS—The general features of lock illumination, both exterior and interior, were fixed during the year. For exterior lighting concrete lamp standards will be erected on the coping of the locks approximately 100 ft. apart throughout the entire length of each wall. In all there will be 211 lamp standards at Gatun, 131 at Pedro Miguel, and 169 at Miraflores, a total of 511. The standard is of special design and supports a reflector about 30 ft. above the coping level. The reflector is intended to throw the light of a 400-watt Tungsten lamp outward over a ship in the lock chamber and also to produce a uniform illumination over the surface of the wall, without the glare occasioned by the brilliancy of the lamp shining directly into the eyes of an approaching pilot. For use at night, or when repairing machinery, artificial illumination is provided by the ordinary 16-cp. carbon filament lamps mounted in specially designed reflectors set in the concrete of the ceiling and walls. A total of about 7000 lamps will be installed in all the locks.

SAILING THROUGH THE CANAL AT NIGHT—To enable a pilot to keep his course up to the turning point it is necessary to have a range of two lights at each end of the longer tangents in prolongation of the sailing line. The prolongations of these tangents on which the lights are situated were covered by heavy growths of brush and timber, so that trocas had to be cut through the jungle until suitable locations were found. These trocas are the width of the canal at the beginning and narrow down to 480 ft. at the end.

Field forces were organized and construction work begun on the range towers at the Pacific entrance Sept. 1, 1911. The towers, which are of concrete, are being constructed by means of steel forms, which are designed for the three types of towers used in the Atlantic and Pacific sections. The forms are 4 ft. in height and of such size as to be easily handled

by two laborers. They are made in segmental sections or staves, and when the form is shifted to a higher position the desired taper is given by omitting a section entirely or substituting a narrower one. One set of forms answers for all towers of the type used in the sea-level sections and another set for all towers of Gatun Lake. The forms for the watch room and lantern room are set up and filled when the body of the tower has been finished. Eleven of the towers required by the system have been completed to date.

The position of 60 gas buoys was located, referenced and checked, and three beacons in the Gatun Lake section located. The illuminants will be gas and electricity, the latter wherever the light is sufficiently accessible. For the floating buoys and for the 23 towers and beacons which are in inaccessible places, compressed acetylene, dissolved in acetone, has been adopted. White lights will be used throughout, and, in order to eliminate the possibility of conflicting the lights with one another and with the lights on shore, all range lights, beacons, and buoys will have individual characteristics formed by flashes and combinations of flashes of light and dark intervals.

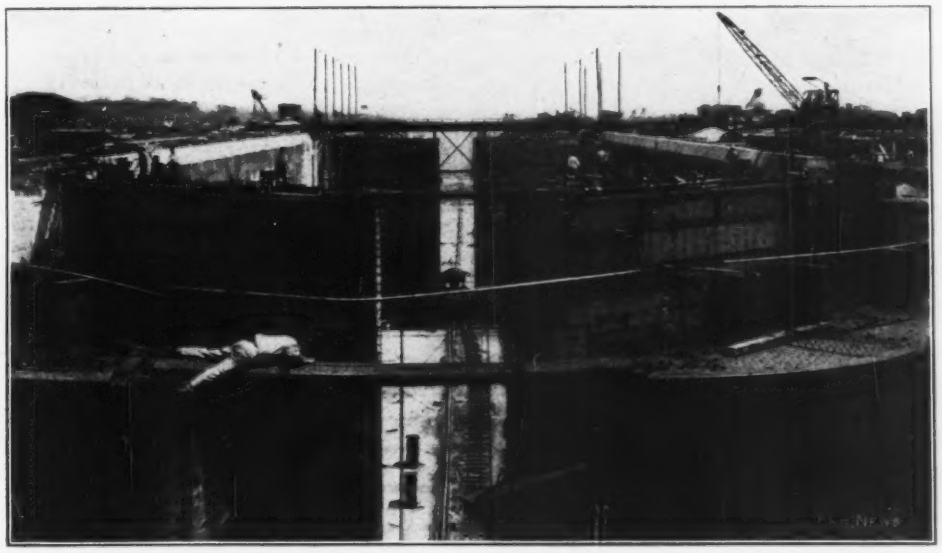


FIG. 2. THREE SETS OF LOCK GATES BEING ERECTED IN WEST CHAMBER OF GATUN UPPER LOCKS, MARCH 12, 1912

ATLANTIC DIVISION

This work is in charge of Lieut.-Col. William L. Sibert, U. S. A., as division engineer.

At the close of the previous fiscal year the excavation necessary for the construction of so much of the Gatun Locks as lie above the lower caisson sills was completed, with the exception of the excavation for the lateral culverts in the lowest lock. This was completed during the fiscal year just ended, at a cost of $2.9598 per cu.yd. The material to be excavated in order to permit the construction of the portions of the locks included the wing walls and approach pier at the north end consists, for the most part, of mud to soft to support steam shovels, as the water cannot be entirely excluded, so that recourse must be had to dredging. It is estimated that 89,570 cu.yd. will complete the excavation necessary to permit unwatering of the area, so that the construction of the wing walls and north center approach pier can be begun. In order to secure suitable foundation, it was necessary to excavate in places to a depth of 70 ft. below sea level, which required closing the opening through which the dredges were admitted by an earth dam and lowering the water so that the dredges could work to this depth.

The total amount of masonry—concrete and large stone—laid by the concrete plant, auxiliary plant, portable mixers, and by hand aggregated for the year 451,025 cu.yd.; of this amount, 59,883 cu.yd. were reinforced. Of this total, 371,388 cu.yd. were laid during the time the 12-hr. day was used, so that only 79,637 cu.yd. were laid since Jan. 31, 1912. The division cost of the masonry was $7.7552 per cu.yd. The large stone laid in the concrete, aggregating 14,194 cu.yd., cost $1.3283 per cu.yd. delivered in the concrete, resulting in a saving of $49,300. The total amount of concrete laid in the locks to the close of the fiscal year was 1,875,965 cu.yd., at an average cost of $7.1142 per cu.yd. On the basis of 2,000,000 cu.yd., the masonry work of the Gatun locks was 93.80% completed.

Crushed stone for the concrete of the locks and spillway was obtained from the Porto Bello quarry until Apr. 30, 1912, when the crusher plant was shut down. The total amount produced up to the time that the quarry was shut down agregated 440,413 cu.yd., at an average cost of $1.4280 per cu.yd. The output of the crushers averaged 217.60 cu.yd. per hr. in service and 436.56 cu.yd. per hr. crushing. The material was transported to Gatun in barges, thence transferred to the stock piles. The cost delivered in the stock piles at Gatun averaged $2.4952 per cu.yd.

Sand was obtained from Nombre de Dios by use of dredge "No. 4" until Nov. 17, 1911, when the sand-storage pile at Gatun was filled, the work was closed down, and the plant removed. The operations of other departments at this locality also ceased. The total amount secured from July 1, 1911, to this date, 144,123 cu.yd., was transported in barges to Gatun. The cost per cubic yard in the stock pile was $2.2414.

WORK ON GATUN DAM—The cross-sections of Gatun Dam taken in June, 1912, show that during the fiscal year the dry fill was increased by 2,544,526 cu.yd. and the hydraulic fill by 2,543,086 cu.yd. In obtaining this amount of 5,087,612 cu.yd. of net fill, 9,048,896 cu.yd. of material (borrow-pit measurement) were handled; in other words, there was a loss of 43.8%. The dry fill in place in the dam shows a loss of 15.53% resulting from consolidation in the mass of the dry fill and from its intermixture with the hydraulic material. The wet fill, measured in place, shows that a loss of 56% resulted, due mainly to waste of soft material in suspension through the drain pipes, leakage from the pipes, and general consolidation.

The cost per cubic yard of dry fill averaged $0.5174 and for wet fill $0.3844 per cu.yd., on the basis of material handled; on the basis of actual increase in the dam, these costs were $0.5303 and $0.3938, respectively.

The hydraulic fill was pumped into the dam by five pipe-line dredges working in borrow pits upward of one and a half miles distant, the maximum lift of the material being 100 ft. For the longer pipe lines and higher lifts, one or two relay pumps were installed to assist the dredges.

The original plan of the dam, given in the report of the Board of Consulting Engineers for the Panama Canal, dated Feb. 5, 1906, contemplated a width of 100 ft. at a height of 135 ft. above sea level, with side slopes on the upstream side of 1 on 3 to elevation 90 and then 1 on 2 to elevation 135. On the downstream face the slopes, starting at the top, were to be 1 on 2 down to elevation 88, then 1 on 25 to elevation 20, 1 on 50 for the next 10 ft. in elevation, terminating with a slope of 1 on 2 to sea level.

During 1908 difficulty was experienced with one of the Panama R.R. embankments on the relocation south of Gatun, which necessitated spreading the lower courses of the fill. In this case the slope of the line jointing the top of the completed embankment with the bottom edge of the bench which was constructed to spread the foundation over the relatively

soft area was between 1 on 7 and 1 on 8. Assuming this for the slope of the dam, the division engineer prepared a plan of cross-section in January, 1909, in which the upstream slope from elevation 60 was fixed at 1 on 7.67 to elevation 105, where the width was 100 ft., and the downstream slope was 1 on 11.63, continuing to elevation 30.

In 1909, when the board of engineers appointed by the President visited the Isthmus with the President-elect, for the purpose of reviewing the project to determine whether any change should be made as the result of the slip which had occurred in the rock fill on the south toe of the dam, the proposition of reducing the height of the dam and flattening the slopes was submitted to it. The board's report was accompanied by a typical cross-section of the dam which it advocated and which was adopted. The height of the dam had been reduced 20 ft., or from elevation 135 ft. to elevation 115 ft. The slopes on the upstream side are 1 on 7.67 to elevation 90, with a horizontal berm 30 ft. wide at elevation 60, and then 1 on 4 to the full height, or 115 ft.

On the downstream side slopes from the top down were fixed at 1 on 4 to elevation 90, thence 1 on 8 to elevation 60, from which to elevation 30, 1 on 16 was adopted. Below elevation 30, where a berm was provided, the slope was 1 on 8 to sea level.

According to this cross-section, which will be found in the annual report of 1909, the hydraulic fill was to extend to elevation 100, where it was to be 100 ft. wide and topped by 15 ft. of rock fill. On the upstream side the hydraulic fill was to have a slope of 1 on 2, and in the interval between this fill and a 10-ft. thickness of rock on the outer slope of the dam was to be the "cheapest filling available." On the downstream side the hydraulic fill had a slope of 1 on 2 down to elevation 55, and thence to sea level on a slope about parallel to the slope of the dam, the interval between the fill and the exterior slope of the dam to be of the "cheapest filling available, rock fill preferred for surface of slopes."

The construction of the dam proceeded in accord with these recommendations, except that for construction purposes authority was given to continue the practically 1 on 8 slopes on upward, the change of slopes to be made later. The cheapest filling available was that supplied by the dredges, and it was evident that if this did not dry out properly a condition might arise which would result in producing such a head against the dry fill that a blowout might occur. Accordingly, in November, 1909, instructions were given to increase the quantity of dry fill on both the upstream and downstream sides, encroaching if necessary into the hylraulic fill so as to secure, outside of the latter, masses such that any hydrostatic pressure that might be produced by the hydraulic fill would tend to act downward on the exterior masses instead of upward and outward. The drying out that had been tried in the dry season of 1910-11 showed an unsatisfactory condition regarding the consolidation of at least the central portion of the hydraulic fill in that part of the dam east of the spillway, but it was believed that if construction proceeded along the lines of the instructions given the soft material would be squeezed out as the height of the dam increased.

In order to determine the settlement that was taking place in the dam, observations were required on hubs located as described in the last annual report and a monthly record kept. These observations showed a gradual settlement until on Oct. 12, 1911, a movement occurred in the east half of the dam. On the north side, for a length of approximately 1000 ft., the top of the dry fill settled 4 or 5 ft. This vertical movement was accompanied by a horizontal movement, greatest at the 75-ft. contour, where it amounted to 14.2 ft., and gradually diminishing down the slope to the 31-ft. contour, where the horizontal displacement was about 3.2 ft. in a length of about 700 ft. While the crest of the slope moved downward, the lower portions of the slope were bulged upward to a certain extent, measurements showing a rise of 1.25 ft. on the 60-ft. contour at a point 1150 ft. from the center of the spillway channel.

The movement was within the dam, as was verified by a test pit sunk where the bulging was greatest, which also showed that the masses of dry fill desired had not been secured. Material was piled to the north of the 31-ft. contour, giving additional weight to the toe, and a blanket of spoil sufficient to make a continuous slope from the 31-ft. berm to the top of the dam was placed over the north face. There was no motion after this additional weight had been added other than the gradual settlement.

In addition to these steps, instructions were issued to pump sand into the hydraulic fill along the 1000-ft. length where the settlement occurred at the top, and to bring the dry fill up on the regular slopes, gradually crowding the hydraulic fill until the distance between the dry fills on the two sides was 25 ft., after which the hydraulic fill was to be covered with red clay secured from the vicinity and properly tamped wet until a height of 103.35 ft. was reached, where the thickness would be 100 ft. It is proposed to continue observations and ultimately to bring the dam to 105 ft. above sea level and, if necessary, subsequently to raise it to the height originally advocated.

A movement occurred about the same time on the south slope, the greatest lateral motion being 6.5 ft. on the 75-ft. contour. On the 60-ft. berm there was a lateral movement of 0.5 ft. A heavy toe was added on the 60-ft. level, extending from the dam to the spillway channel wall and to the berm.

In adapting the cross-section proposed by the board in 1909 to the ground, the slopes were modified where the dam is practically a blanket over the spur projecting from the hills on the west side against which the dam abuts, and here the plan proposed of making the upstream slope 1 on 4 and the downstream slope 1 on 5 was approved. As dry fill was added on the upstream face of the hill a condition developed indicating that the material on the bottom extending out from the foot of the hill would not bear the weight, so that it was necessary to flatten the slope, which was accordingly authorized to be 1 on 7.67. A heavy fill was placed on the ridge that was pushed up outside of the toe of this slope, and, in addition, one of the dredges operating to the south of the dam extended the foundation outside of the rock fill by distributing material over the bottom, thus adding to the spread given the foundations.

In the channel between Gatun locks and the Atlantic Ocean, excavation in the dry was continued through the Mindi Hills and, with the exception of the dike separating the cut from the French canal, was completed on Feb. 24, 1912.

The dredges which operated between the Mindi Hills and deep water in the Caribbean in excavating from the canal prism were the seagoing dredge "Caribbean," 5-yd. dipper dredges "Chagres" and "Mindi," and the French ladder dredges "No. 1" and "No. 5." They removed 3,859,445 cu.yd. of earth and 495,595 cu.yd. of rock. Channel silting during the year amounted to 3,036,000 cu.yd., making the net earth excavation in this section 823,445 cu.yd.

Central Division

The work of this division embraces all the excavation between the Gatun Dam and Pedro Miguel Locks. The work is in charge of Lieut.-Col. D. D. Gaillard, U. S. A., as division engineer.

The total amount removed in the Chagres section during the year aggregated 560,509 cu.yd., leaving 151,000 cu.yd. of wet excavation still remaining.

During the fiscal year 16,476,769 cu.yd. of material were removed from the Culebra Cut and, from estimates prepared on July 1, 1912, 11,863,540 cu.yd. remained to be removed in order to complete this section of the canal. The amount remaining was again increased over that reported a year ago by 3,595,000 cu.yd., in order to allow for slides already existing at the beginning of the fiscal year and for excavation along the upper levels of the banks of the canal, where slides had developed or were anticipated, and outside of the canal prism lines.

The total amount of material removed during the year outside of the slope lines and because of slides aggregated 5,915,000 cu.yd., or 35.90% of the total amount of material removed from the cut as against 30.07% during the previous fiscal year. The total amount of material due to slides so far removed aggregates 16,671,000 cu.yd., and the estimated amount remaining is 3,595,000 cu.yd. At the Cucaracha slide, which has been practically at rest for over a year, the angle of repose is somewhat steeper than 1 on 5, while the Culebra slide on the west bank, where the material is still moving, the present slope is about 1 on 5. In the slide on the west bank of the canal just north of the village of Culebra, the moving material is of stratified rock moving in mass on a layer of lignite which has an inclination of 1 on 7. This slide developed early in the dry season. These very flat slopes of the bank in the deepest portions of the cut explain the large amount of material added by slides and breaks over the original estimates. A number of relatively small slides developed as the cut was deepened, but the largest one now in motion is that which results from a break in the west bank of the canal at Culebra and covers an area of about 63 acres. From this slide 2,710,000 cu.yd. were removed during the fiscal year just ended, making a total thus far taken out of 6,765,000 cu.yd., and leaving still to be handled an estimated amount of 1,300,000 cu.yd. The next largest slide lies on the east side of the cut, opposite Culebra, and covers an area of 50.7 acres. From this slide 1,960,000 cu.yd. were removed during the past fiscal year, making a total of 4,290,000 cu.yd. that have been taken out since it started, in 1907; it is estimated that 600,000 cu.yd. still remain.

Thus far increases in the estimates of material to be removed, made necessary by the slides, will cause no increase in the total estimated cost of Culebra Cut, as the division costs were reduced during the past year, effected in part by increased efficiency of the organization, by the fewer interruptions in the transportation service by slides and water, by the better conditions generally of the dumps, and by the upkeep of the output, due to the amount removed by the shovels on the upper reaches. It is also of interest to note that none of the slides which occurred during the year would have interfered with the passage of ships had the canal been in operation.

The Naos Island Dike or Breakwater is to extend from the shore at East Balboa to Naos Island, a distance of 3.29 miles from the mainland, and is constructed for the purpose of cutting off silt-bearing currents from the excavated channel in the Pacific, thereby reducing the cost of maintenance and making navigation of the channel easier by eliminating the cross-currents.

In constructing the dike, a pile trestle is being driven from which material is dumped. Prior to June 30, 1911, the trestle had been constructed for a total distance from the shore line of 2.78 miles. During the fiscal year this trestle was extended 1360 ft., giving a total length of trestle constructed to June 30, 1912, of 16,051 ft., or 3.04 miles. The length of the trestle on June 30, 1912, was 1320 ft. from Naos Island, and the fill was extended to within 2000 ft. of its end, or 3320 ft. from the island. Much trouble was experienced during the past two years in extending the fill, due to the sliding of the bottom under pressure, caused by the weight of the stone dumped from the trestle. The total vertical settlement at one locality on the dike during the year aggregated 125 ft.

The elevation of the top of the trestle is 14 ft. above mean tide, and the average depth of water for the last mile of trestle constructed is about 15 ft. at mean tide, giving a total height of trestle of about 29 ft. above the original bottom. When the rock is dumped from the trestle it begins to settle as soon as it attains a height of a few feet, displacing adjacent material which, pushing up, forms a parallel ridge of mud. By the time the rock fill has been completed to full height these parallel ridges are about 80 ft. from the center of the track. Experience shows also that the trestle is pushed out when the fill reaches the height of mean tide and cuts off communication beyond the break.

To lessen the difficulties and to spread the foundations as much as possible, suitable material removed by the dredges in the channel was dumped in front of

FIG. 3. BIRDS-EYE VIEW OF PEDRO MIGUEL LOCKS FROM HILL ON EAST BANK OF CANAL, JULY 28, 1912

the trestle and spread for a considerable distance on either side of the center line. A board appointed to submit a plan for hastening progress on the construction of this breakwater recommended the building of a double trestle, dumping on either side, thereby spreading the fill and continuing the fill to mean tide out to the island, thereby saving the trestle, which is to be made more substantial than formerly. When the fill has been extended to the island it is to be carried to full height, commencing at the island; should a break then occur in the trestle, there would be considerable length of it left to fill over. This was approved, and the double trestle is being built.

The average division cost of excavation for the year, including plant charges and all items which entered into its accomplishment, was $0.5101 per cu.yd.

Pacific Division

The work of this division consists of the construction of the locks and dam at Pedro Miguel, the locks and dams at Miraflores, the Ancon quarry, dredging for sand at Chame, excavating a channel between the locks and below Miraflores Locks to deep water in the Pacific. In addition, excavation necessary to prepare for work on the terminals, including coaling station, dry dock, and machine shops, was placed under this division. The work is in charge of S. B. Williamson as division engineer.

At Miraflores excavation of the lock pit was continued, and resulted in the removal of 624,747 cu.yd., exclusive of that for preparing foundations. The average cost for lock excavation was $0.6566 per cu.yd. The surface of the rock on which the Miraflores Locks are founded dips rapidly at the north end of the site. The walls were originally located with their northern extremities on rock which was only a few feet above the desired grade. After the excavation for the locks had been begun, changes in design necessitated extending the walls 98 ft. farther north, thereby not only increasing the amount and depth of excavation required to secure suitable foundations, but adding materially to the difficulties and cost.

The total amount of concrete placed in the Miraflores locks during the past year was 751,540 cu.yd., made up of 729,096 cu.yd. of plain and 22,444 cu.yd. of reinforced concrete. The construction and auxiliary plants placed 401,079 cu.yd. and 350,461 cu.yd., respectively. The total amount of masonry laid in the locks on the Pacific side was therefore 934,410 cu.yd. and 174 cu.yd. in the wing walls. The average cost of the concrete placed was $4.5867 per cu.yd. of plain concrete and $10.6388 per cu.yd. for reinforced concrete.

The total amount of concrete laid in the Pacific division locks to July 1, 1912, aggregated 1,874,029 cu.yd., at an average cost of $5.0264 per cu.yd. There remained to complete the locks 51,150 cu.yd. at Pedro Miguel, as already noted, and 386,729 cu.yd. at Miraflores.

The crushed stone for concrete in the Pacific locks was obtained from the Ancon quarry which, with the crusher plant, was operated throughout the year. The total amount produced by the plant was 839,279 cu.yd., at a cost of $0.6720 per cu.yd. in the bins. The cost of stone delivered in the stock piles at the locks was $0.7996 per cu.yd.

Sand for the lock masonry and other concrete construction was obtained from Chamé Bay, located about 20 miles west of Balboa. It is secured by dredging, thence loaded into barges, towed to Balboa and transferred to bins by rapid unloading cranes. During the year 564,837 cu.yd. were unloaded, at an average operating cost of $0.1177 per cu.yd., exclusive of charges for plant. From the bins it is loaded by gravity into cars and transported to the storage piles at the lock sites or to such other points as may be desired. The cost of the sand in stock piles was $0.7025 per cu.yd.

Excavation of the channel by steam shovels between Pedro Miguel and Miraflores and south of the latter was continued; 864,475 cu.yd. were removed during the year, of which 411,987 cu.yd. were of earth and the remainder of rock. The average cost was $0.7527 per cu.yd.

The hydraulic excavation plant was in operation throughout the year in the sea-level section of the canal south of Miraflores and excavated 900,596 cu.yd. of material. The total cost of handling this material, earth and rock, was $0.5564 per cu.yd.

The dredges operating in the canal during the year below Miraflores were the 20-in. seagoing suction dredge "Culebra," the 5-yd. dipper dredge "Cardenas," three French ladder dredges, and, for a period of three months at the close of the fiscal year, the new ladder dredge "Corozal." During the year the dredges removed 4,683,902 cu.yd., at an average cost of $0.19 per cu.yd. There remained at the close of the fiscal year to complete the excavation in the channel 4,194,059 cu.yd., including 700,000 cu.yd. estimated allowance for silting.

Second Division, Chief Engineer's Office

This division has charge of all mechanical questions that may arise and supervise expenditures and allotments for the week. The third division of the chief engineer's office was abolished on Jan. 24, 1912, after the resignation of C. M. Saville, assistant engineer formerly in charge, and the work transferred to the second division. To this division was also assigned the design of the dry dock, coaling stations, shops, and appliances in the form of harbor tugs, cranes and barges. The division is in charge of H. H. Rousseau, U. S. N., as assistant to the chief engineer.

On the assumption that favorable legislation would be provided, general and detailed plans of the terminals were undertaken with a view to beginning work of construction as soon as funds should become available. The general layout of the terminals at the Atlantic and Pacific entrances to the canal is arranged with the object of affording sufficient wharves and piers to meet all requirements when the canal is opened, and at the same time to permit of extension in case future needs so require. In addition to wharf space for vessels, the general plan provides the necessary facilities for docking and repairing all classes of vessels and for furnishing them with fuel, fresh water, and supplies of all kinds. As these facilities may be required for military purposes as well as commercial, all general plans were submitted to the Navy Department for its views, which have been followed in the final designs.

The main coaling plant at the Atlantic end of the canal will be capable of handling and storing 200,000 tons of coal, with a possible increase of 50%; 100,000 tons will be in subaqueous storage. The coaling plant at the Pacific terminus will be located at Balboa, adjacent to the site of the dry dock, and will be capable of handling and storing 100,000 tons of coal, with a possible increase of 50%.; subaqueous storage will be provided for 50,000 tons. Arrangements are made for supplying fuel oil, and four tanks of 40,000 bbl. capacity each are under advertisement, which will give an initial storage capacity of 80,000 bbl. at each terminus.

The piers or docks on the Atlantic side are to be protected against storms by a mole or breakwater extending out in prolongation of the line separating the Zone from Colon. They are to be 1000 ft. in length, 209 ft. in width and 300 ft. apart. On the Pacific side the piers for commercial use will be placed at right angles to the axis of the canal, with the ends of the piers 2650 ft. from the center of the 500-ft. canal channel. The piers will be 1000 ft. long and 200 ft. wide, with 300-ft. slips between the piers. The construction of one pier is to be undertaken.

The superstructure of the commercial piers and wharves will be one-story steel sheds, with a clear height of 25 ft. The sheds, of fireproof construction, will cover the entire pier except for a space of about 18 ft. along each side and the outer ends. A track will extend along each edge of the piers at floor level, and two tracks will run through the center of the pier sheds, so depressed as to bring the car floor level with the floors of the sheds. Much study was given to providing for the economical handling and storing of freight at the terminals, but the best type of cargo-handling ap-

pliance cannot be determined at this time, as the amount of freight that will be moved from ship to ship at the terminals or will require storage is at present unknown.

The plans provide for one dry dock capable of accommodating any vessel that can pass through the canal locks. It will have a usable length of 1000 ft., an entrance width of 110 ft., and a depth over the keel blocks of 35 ft. at mean sea level. The dock will be built in the rock, which will be lined with concrete after it has been excavated. The borings indicate that the rock is strong, solid, and well suited for such construction.

In lieu of the marine railway at first contemplated for smaller classes of vessels, an auxiliary dry dock will be provided, and a suitable foundation on similar rock has been found for it. This dock will have a usable length of 350 ft., a width at entrance of 71 ft., and a depth over the keel blocks of 13½ ft. at mean tide. On the Atlantic side the present dry dock at Cristobal, which has a usable length of 300 ft. and a width at entrance of 50 ft., with a depth over the sill of 13 ft. at mean sea level, will be retained.

Plans for the various shops, foundries, storehouses, and subsidiary buildings have been approved, and specifications are prepared for furnishing the material, as it is desirable to have the erection completed and the machine shops moved from Gorgona by July 1, 1913. The machines now in use will be installed in the new shops, and they will be electrically driven, both individual and group drives being used. The floor area of the buildings in connection with the shops aggregates 491,380 sq.ft.

For the expeditious and convenient handling of lock-gate leaves, as well as for commercial and other canal needs and for general wrecking purposes, it will be necessary to provide a floating crane of the largest practicable capacity at each terminus of the canal. An investigation is now under way to determine the best manner in which these requirements can be filled.

For handling vessels of the largest size, harbor tugs of high power will be required and must be secured, as the tugs now owned by the commission will not be satisfactory or economical for that service. It is intended to provide two large harbor tugs at each end for this purpose.

It may be reasonably expected that a large quantity of coal will have to be furnished to shipping in barges or lighters, so that the canal must be equipped with a sufficient number, not only for this service but also for supplying fuel oil and fresh water. The Navy Department has recommended that provisions be made for sufficient lighters to give a capacity of 16,000 tons of coal for the Atlantic terminus and 8000 tons for the Pacific end. This will be done.

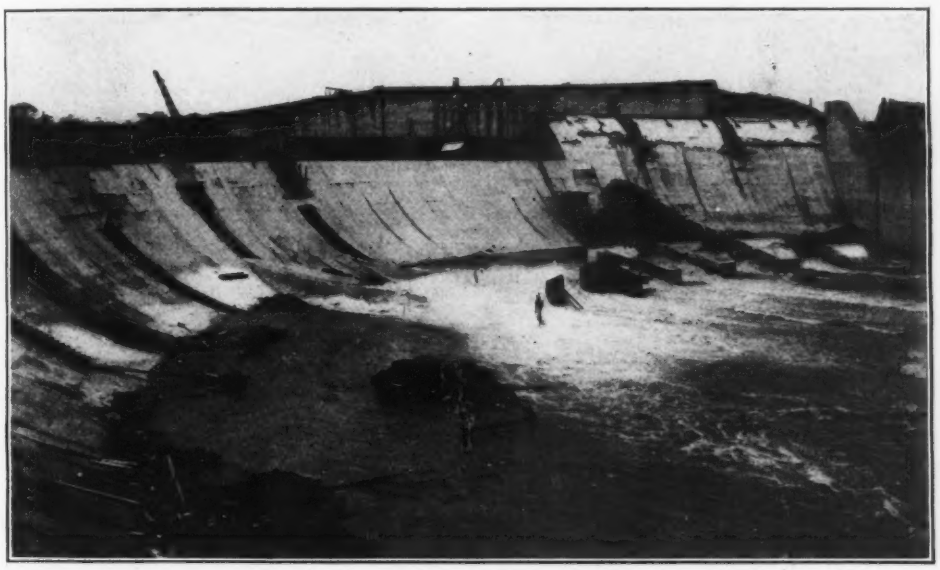


FIG. 4. DOWN-STREAM FACE OF OGEE DAM FORMING SPILLWAY OF GATUN DAM, JUNE 6, 1912

During the year the locations of the permanent administration building and canal headquarters and the permanent settlements for employees have been determined. The permanent administration buildings will be on a knoll west of Ancon quarry, and quarters for employees attached thereto will be erected in the general area adjacent to and northeast of this building. Employees connected with the shops, docks, and other terminal facilities will be housed in quarters erected in the area surrounding the slope of Sosa Hill and on the fill adjoining the Ancon-Balboa highway. There will be a permanent settlement at Pedro Miguel for employees of the Pacific locks and one at Gatun for employees of the Atlantic locks. The settlement at Cristobal will be maintained and also the one at Ancon.

The operation and maintenance of the air-compressor plants at Las Cascadas, Empire, Rio Grande, and Balboa are also under the mechanical division. The output of all air-compressor plants operated during the year was 8,795,157,453 cu.ft. of free air at 70° F., which was compressed and distributed at 100 lb. pressure, at an average cost for the year of $0.0312 per thousand cu.ft.

The total appropriations made by Congress up to June 30, 1912, amounted to $293,561,468. By act approved Aug. 24, 1912, additional appropriations were made for the fiscal year 1913 amounting to $28,980,000, exclusive of fortifications. On June 30, 1912, $259,653,236.74, or about 69% of the total estimated cost, had been charged into the work. Of this amount, $34,183,183.48 were expended during the fiscal year 1911, or about 9% of the total estimated cost of the canal. Of the total classified expenditures to June 30, 1912, $32,547,720.75, or about 12½%, were for plant and equipment for construction and for four steamships.

CONSTRUCTION OF THE NEW PANAMA R.R.

The construction of the new or relocated line of the Panama R.R. was continued by the engineering department of the Panama R.R. Co. during the year and was in charge of Lieut. Frederick Mears, U. S. A., as chief engineer of the Panama R.R.

At the beginning of the year construction work was confined to the stretch of road from Gatun to Gamboa. The largest embankment on this section of the railroad is 4800 ft. long across the Brazos bottom. The rock in this valley is from 150 to 200 ft. below the surface of the ground, which is of fairly good clay from 20 to 30 ft. thick, but between this and the rock the material is very soft.

The embankment, which is 61 ft. high, was given side slopes of 1 on 2 with the hope that this would spread the foundation sufficiently to enable the layer of clay to support it without disturbing the soft strata. Just before the full height was reached, however, the pressure became too great and the soft material moved out, upheaving the natural ground beyond the toes of the slopes.

When this occurred the base was widened so as to secure a slope of about 1 on 3 before any weight was added to the upper level, after which the embankment was completed to grade.

Trouble with settlements was encountered in the fills over the Quebrancha and Baja bottoms, where it was necessary to spread the base so as to secure a slope of 1 on 4; these fills were 72.70 and 68.70 ft., respectively, above the natural surface of the ground. In the 3 miles covered by these bottoms, 4,736,072 cu.yd. of material were placed, or an average of 1,578,690 cu.yd. per mile, all necessary to secure a permanent roadbed above the proposed lake level.

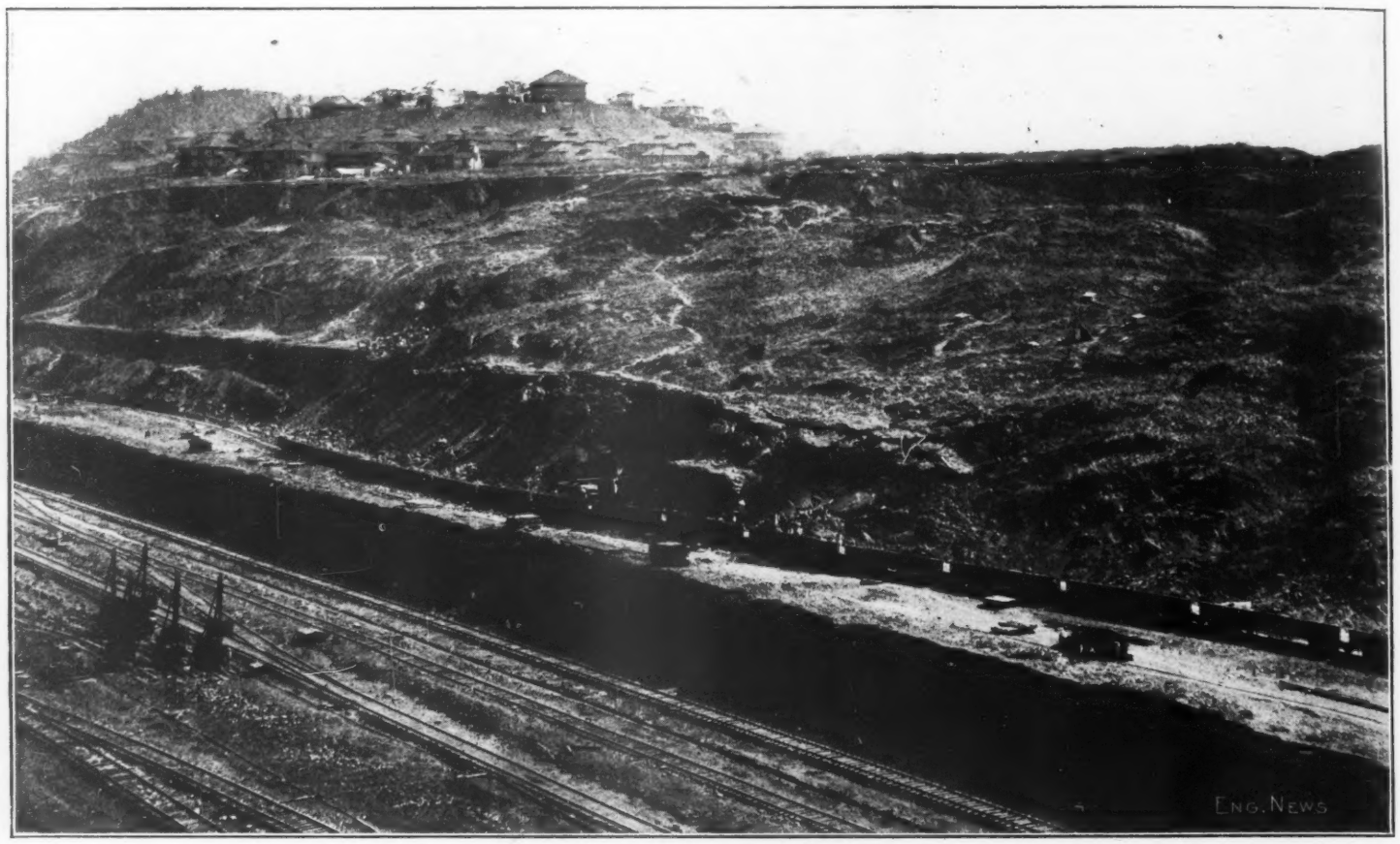


FIG. 5. THE GREAT SLIDE AT CULEBRA, FEBRUARY, 1912

(This slide of stratified rock on the west bank of the canal at Culebra involved about 900,000 cu.yd. and moved about 5 ft. per day on a slope of 1 vertical to 7 horizontal)

Laying the remainder of the permanent track was completed as far as practicable by Feb. 15, 1912. The track is of 90-lb. openhearth steel, 100% splice bars, and either creosoted or hardwood crossties fitted with "Economy" tie-plates and screw spikes.

The slides on the east side of Culebra Cut and the necessity of maintaining through communication caused the construction of a high line around Gold Hill and the abandonment of the original plan of carrying the railroad on the 95-ft. berm through Culebra Cut. It was hoped that eventually the high line might be abandoned in favor of the 95-ft. berm, but all thought of this has been given up on account of the excessive cost of rebuilding this berm throughout the cut. The Gold Hill line summit is near the La Pita divide at elevation 271 ft. above mean sea level, and the continental divide is crossed opposite Culebra at an elevation of 241 ft. above mean sea level.

During the year 3,209,021 cu.yd. of grading were completed at an average cost of $0.345 per cu.yd.

FIG. 6. VIEW OF CULEBRA CUT AT EMPIRE, LOOKING NORTH FROM WEST BANK

(The steam shovels are working on the final bottom of the canal at elevation +40)

COST KEEPING

The methods of cost keeping adopted on Jan. 1, 1910, were continued throughout the year.

Excavation in the prism by steam shovels was cheapest in the Central division, averaging $0.5101; in the Atlantic division a lower cost is shown than during the previous year—$0.5952 against $0.6010—while in the Pacific division it is higher—$0.7527 against $0.6960. There was a total of 1,443,570 cu.yd. of masonry laid in the locks and spillway during the year. The unit costs for the masonry were: Gatun Locks, $7.7552; Gatun spillway, $7.0988; Pedro Miguel Locks, $6.4640; Miraflores Locks, $4.7675. The labor costs for the year per cubic yard of plain concrete at the various locks and spillways show lowest at Miraflores, $0.8394; next, Gatun Locks, $1.3840; Pedro Miguel Locks, $1.4733; and Gatun spillway, $1.5425.

The cost of concrete piling at Gatun was $0.0679 less during the year than in 1911, while the cost in place was $0.7088 less. The total amount driven was 83,670 lin.ft., at a cost of $1.5719 per lin.ft.; in addition, 51,450 lin.ft. of wooden piles

were driven, at a cost of $0.6516 per lin.ft. On this basis had wooden piling only been used for the south approach pier a saving of $77,000 would have resulted.

Department of Sanitation

This department has charge of sanitary work in the cities of Colon and Panama and, except oiling, it designates the sanitary work to be done in the Canal Zone. In addition, the department has charge of hospitals and quarantine. It is in charge of Col. William C. Gorgas, U. S. A., as chief sanitary officer.

The work in the terminal cities consists in cutting grass and brush, oiling pools, constructing and maintaining ditches for drainage purposes, removal of garbage and night soil, fumigation, and street cleaning. The work done in Panama consisted in cleaning 398 miles of ditches, digging 2.5 miles of ditches, and clearing 118 acres of weeds and grass, in addition to oiling, disinfecting, and fumigating. In the Colon district, from the same source, 112.5 miles of ditches were maintained, 8 miles of ditches constructed, and 217 acres cleared of vegetation, in addition to oiling, disinfecting, fumigating, etc.

The impression is general elsewhere than on the Isthmus that the sanitary work, in the way of clearing land, extends over the entire area included within the limits of the Zone, so that it is interesting to note in this connection that of the 278,848 acres comprised within those limits less than 1200 acres are kept cleared for sanitary purposes and on sanitary requests, outside of the military reservations, where the work is done by the troops.

Almost the entire Zone is in its original condition as regards brush and jungle.

The total expense for sanitary work in the Canal Zone and in the cities of Panama and Colon was $596,608.73, of which $67,968.19 were for sanitation proper in the two cities, $409,205.84 for sanitation proper in the Zone, $18,672.50 for removal of garbage and street cleaning in the two cities, and $100,760.20 for removal of garbage and street cleaning in the Zone.

Reporting on the health conditions on the Isthmus, the chief sanitary officer states that the total admissions to hospitals and sick camps, including those sick in quarters during the year, was 48,307; that the daily average sick was 22.91 out of every thousand employees as against 24.77 for 1910-11 and 23.01 for 1909-10 on the basis that the total numbers employed during the years mentioned were 50,008, 49,129, and 50,535, respectively; that the total number of deaths among employees was 508, of which 35 were Americans, 79 were white employees of other nationalities, and 394 were blacks; that the total number of deaths from violence among all employees was 154, as against 178 for the preceding year.

Date of Completion of the Canal—A year has passed since the last annual report, in which was noted the dates by which the various parts of the work were to be completed, and the situation has been modified somewhat, so that more accurate information can be given than was possible at that time. The division engineer of the central division reported at the close of the year that if no more material due to slides had to be removed than the increase which the revised estimates of July 1, 1912,

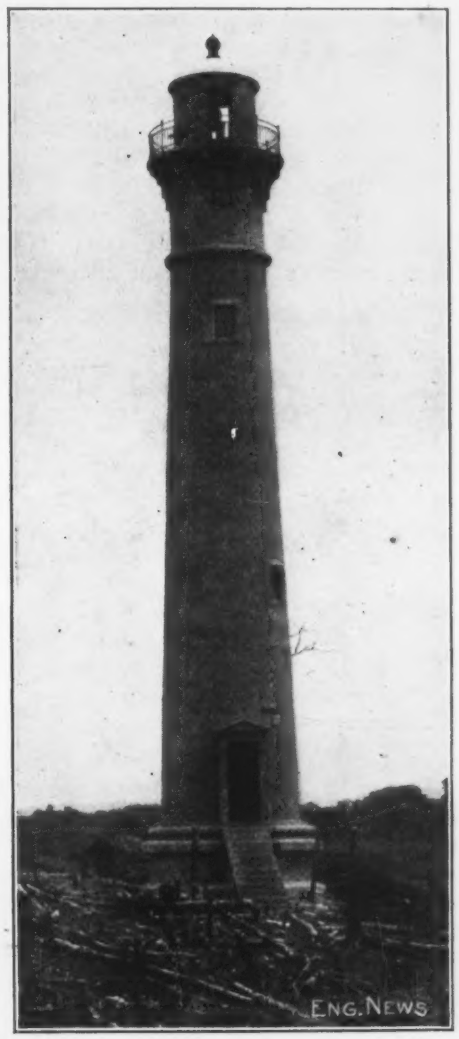


Fig. 7. Concrete Beacon Tower for Range Light on Shores of Future Gatun Lake

contemplated, the excavation through Culebra Cut would be completed by July 1, 1913, or the same date as was fixed a year ago. Though additional slides have occurred since the close of the fiscal year, there has been no decrease in the force, so that it is still possible to complete it as predicted, though the date must depend upon the slides.

In the Atlantic division concrete work at the north end of the locks remains to be completed. As outlined in the report, excavation in the area below by dredging was not begun until February, 1912, and it is reported by the division engineer that, due to slides, the date for completing the concrete will now be June 30, 1913. On account of increase in the additional quantity of dry fill that must be added to the dam, July 1, 1913, is now the date fixed for completing this work, and Aug. 1, 1913, is fixed as the date for completing the Gatun spillway.

In the Pacific division the division engineer now estimates that the locks will be completed in their entirety by Jan. 1, 1913, by which date the dams at Pedro Miguel and Miraflores will also be finished, and that the spillway at Miraflores Locks will be completed by June 30, 1913. The delay of seven months in the delivery of the dredge "Corozal" threatened to cause a delay in completing the excavation in the channel below Miraflores by the amount that it was estimated the dredge would remove in that time. However, a large portion of this excavation will be done by steam shovels, thus reducing the length of time sufficiently to permit the completion of the channel by June 30, 1913.

As already noted, the contract for the lock gates has not been carried out as rapidly as was anticipated, and the contractor has been called upon to finish the gates in one flight of locks first, so that, if the rest of the work is in condition, passage of ships can be permitted by the use of one of the flights instead of both. While delays have occurred in the delivery of the lock machinery and accessories, the assistant chief engineer is so organizing his work as to have completed sufficient machinery to meet the conditions that the lock-gate contract will furnish. It is probable that certain features of the work will not be finished until some time after the first vessel passes the locks. These are features, such as the power-generating station, the transmission line, the aids to navigation, etc., which, though important in themselves, are not essential to the preliminary trial of the system.

[Signed] Geo. W. Goethals,
Colonel, Corps of Engineers, U. S. A.,
Chairman and Chief Engineer.
Culebra, Canal Zone, Sept. 10, 1912.

Water Lubrication of Street-Railway rails has been in use for some time on a street in Rome, Italy, carrying heavy traffic. The street is on steep grade and has numerous sharp curves. At the top of the slope a stream of water is fed into each of the four rails of the double-track line and flows downhill along the groove of the rail. Every 20 to 30 in. a small wooden block is wedged in the groove, reaching up to wheel-flange level, to break the flow of the water. It is reported that cars ride very smoothly on this lubricated track and the grinding noise of cars rounding curves is practically eliminated, while also the general noise of the car traffic is reduced. Grease lubrication at curves is rendered unnecessary. —["Zentralblatt der Bauverwaltung," Oct. 19, 1912.]

Protection for Hollow Reinforced Concrete Plans

By G. L. Bilderbeck*

In Engineering News, of Sept. 5, 1912, p. 446, is an excellent article on "Four Alternate Designs of Hollow Concrete Dams," by Edward Wegmann. When comparing competitive designs of this class, several queries arise, some of which are of paramount importance in the safety of the structure.

These queries may be enumerated as follows:

(1) What precautions have been taken to prevent hydrostatic pressure between the foundation and the masonry of the structure?

(2) What would be the result of a possible injury to the upstream slab causing a sudden and extensive leak?

(3) What precautions have been taken to protect the steel in the expansion joints, if the dam has been built as a unit?

(4) What are the possibilities of excessive floods caused by the breaking of the dams above or otherwise, followed by log jams, etc., which might bring to bear excessive impact on the weir section of the dam?

By way of illustration let us investigate the dam section shown in Fig. 1 of the above mentioned article. It is stable under most any static head that may be applied. In fact, any increase in height of flood, neglecting the transporting power of water, would increase the stability of the dam.

The dam has a continuous floor over its whole section. The floor is continuous under the buttresses and is heavily reinforced so as to form a spread foundation for the whole structure and to tie it together as a unit.

A small cut-off wall is put down on the upstream side to prevent access of water under the foundation. Also a small cut-off wall has been put down from the toe of the dam to prevent wash of material from under the foundation.

This arrangement of masonry would seem to be good, if we did not have abundant proof in recent dam failures that water almost always finds access to the seams between the foundation and masonry, either floating the structure out of place or eroding the foundation until the masonry topples over. Space is too limited to consider in detail any of these failures. Mention of a few will suffice.

The dam at Dansville, N. Y., which failed in December, 1909,* was of the buttressed reinforced-concrete type with a continuous reinforced-concrete slab foundation having cut-off walls at the upstream and downstream edges of the slab. The upward pressure of the water floated this dam, broke the cut-off walls and carried a large section downstream, leaving it in a vertical position. The evidence is *prima facie* that nothing but upward pressure on the bottom slab would have caused the failure and left the displaced section as it was left.

The failure of the dam No. 26 in the Ohio River, Aug. 8, 1912,† must have been caused in the same way. The wicket sections were left in an upright position after the failure.

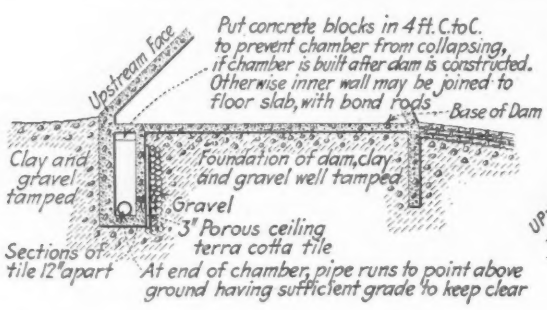

Put concrete blocks in 4 ft. C. to C. to prevent chamber from collapsing, if chamber is built after dam is constructed. Otherwise inner wall may be joined to floor slab, with bond rods
Upstream Face
Base of Dam
Clay and gravel tamped
Foundation of dam, clay and gravel well tamped
Gravel
3" Porous ceiling terra cotta tile
Sections of tile 12" apart
At end of chamber, pipe runs to point above ground having sufficient grade to keep clear

Fig. 1. Infiltration Chamber to Relieve Water Pressure on Masonry at Foundation Plane

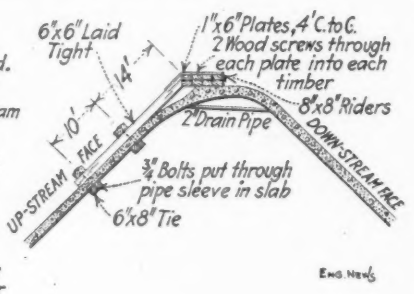


Fig. 2. Timber Flashing to Protect Upstream Slab of Hollow Dam

During the last few years engineering journals have been continually giving accounts of dams that have failed, and the reader will remember that practically every one had no special provision for preventing water from seeping between the masonry and the foundation and thereby causing a hydrostatic pressure on the masonry from the bottom. In view of the mass of evidence constantly bearing out the above defects in ordinary dam construction, it would seem unwise to place a dam on any sort of a foundation without making some provision on account of the possible hydrostatic pressure on the masonry at the plane of the foundation.

To carry the cut-off wall on the upstream face of the dam down to a depth great enough to make it absolutely certain that water could not get beneath it and seep under the foundation would be impractical. The only remedy to apply would be to relieve the presure at once as the water enters the lower strata. The sketch in Fig. 1 carries out this idea perfectly and adds little to the cost of the structure.

The scheme consists of a double cut-off wall with an infiltration gallery between the two walls. The outside of the inner wall is covered with 3-in. porous terra cotta ceiling tile. The blocks should be set on end so the face corrugations and inside channels will form continuous passages permitting water to flow quickly to the outlet. The infiltration gallery should be connected at one end with a pipe line to discharge the collected water by gravity. It will be evident that not only will the gallery act as a drain, but it may be used for the purpose of inspecting the foundation at any time, to locate leaks or settlement.

The fact has been quite well established that steel reinforcement will not corrode if well covered with a dense concrete. This fact does not, however, warrant us in saying that all the steel in a reinforced-concrete dam will not corrode, because the steel at the expansion joints, or cracks, if the joints are not made, is not kept from the air and moisture. This is a defect that has been overlooked largely in the past. It is believed to be of weight because these joints must always exist.

The writer was in one of the hollow concrete dams built on the Ambursen design recently where, so far as could be seen, the slab was intended to be continuous on the upstream side of the dam. Shrinkage or expansion cracks had developed at intervals and through some of them water spurted into the chamber in small streams. It would be folly to assume that steel passing through these cracks would be free of corrosion.

The La Prele dam,‡ in Wyoming, has its upstream slab built up of unit sections, each section being designed as a simple beam. In this dam the steel is safely imbedded because it does not pass over the abutments and consequently through the expansion joints.

In all cases expansion joints should be filled with marine cement, and where exposed as are those on the upstream side of a dam, lead wool should be calked into the joint to the depth of an inch, to prevent the weathering out of the marine cement.

Arriving now at the question of impact of floating bodies we take up a question that is many times wholly neglected. The danger is not, perhaps, due to any tremendous floating mass having sufficient energy to wreck the structure completely, but to the repeated blows of floating logs, ice and wreckage always incident to floods in the spring and winter, or to excessive floods at other times of the year.

No dams of the hollow reinforced-

*Civil Engineer and Superintendent of Construction, U. S. War Department, New London, Conn.

*Eng. News, Jan. 13, 1910, p. 52.
†Eng. News, Aug. 22, 1912, p. 366.

‡Engineering News, Nov. 10, 1910, p. 499.

concrete type have been wrecked up to the present time, as far as the writer is able to find, by floating bodies. The reason for this is probably due to the comparatively short time that this type of dam has been in use.

Great quantities of snow and ice and floating wreckage slowly disintegrate and wear away the surface of the concrete. This effect, together with that of frost which, of course, is most severe on a surface alternately wet and dry, combine to make inroads on the most substantial of materials. The action is necessarily slow when compared with the duration of ordinary events. On the other hand, one could not safely state that a concrete slab a foot thick would resist successfully the combined action of the above forces for more than 30 years, and in many cases for a much less time. It is also safe to assert that most of the dams standing will be left untouched until this event takes place, if nothing else in the way of destructive forces finds the dam unequal to the occasion.

If a large hole is smashed through the slab, the water flowing into the enclosure will neutralize the weight of the water on the upstream side of the dam and thereby render the structure less capable of resisting the thrust of the water. If the opening that is broken through the upstream slab is large enough to admit more water than will pass through the openings in the buttress walls a condition will exist that is much different from any that is usually believed the dam could be subjected to.

By way of explanation, suppose we assume a dam whose section is that of a triangle, 40 ft. wide at the base and 20 ft. high. Suppose a flood exists giving an overflow of 10 ft. Under normal conditions there are a horizontal hydrostatic sliding pressure of 25,000 lb. and a vertical hydrostatic pressure on the upstream face of 25,000 lb. per lin.ft.

Now suppose the upstream slab breaks so as to fill the enclosure with water, an upward hydrostatic pressure will exist on the downstream slab of 25,000 lb., and the sliding pressure will be the same as in normal conditions. The masonry of the upstream slab and buttress walls will have been reduced to less than 100 lb. per cu.ft. in effective weight. It is evident that any of the concrete, one piece, hollow dams would quickly fail in the face of such an event.

It is believed that the above illustration brings out the point that it is necessary to protect the slab near the crest of the weir section of the dam. A sketch in Fig. 2 shows a method of accomplishing this which will obviate most of the danger. This consists of a tier of 6x6-in. flashing beams bolted to the slabs at the positions noted and having fixed at the free end a flat timber rider consisting of 8x8-in. timbers continuous the length of the weir and connected rigidly to the 6x6-in. flashing timbers, but not connected to the slab.

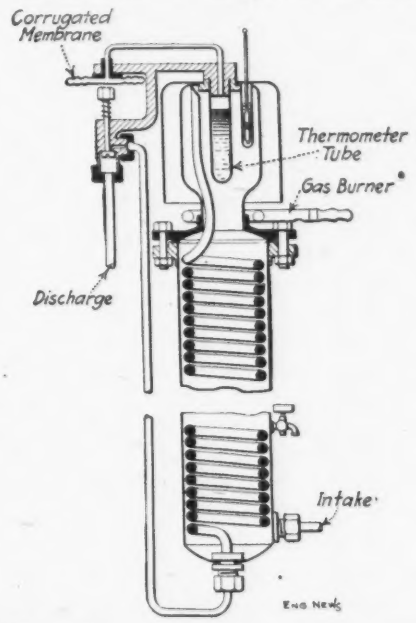
It will be seen that any blow rendered within 5 ft. of the top of the dam will cause the timber flashing to spring, sliding the rider on the concrete surface, thereby absorbing the energy of the blow without transmitting the jar directly to the structure.

The bolts holding the flashing to the slab should pass through the same in pipe sleeves so the timbers may be removed from time to time, and new timbers and bolts replaced.

A pipe drain is carried through the top of the weir to drain the space back of the flashing so water will not be pocketed in the winter and freeze, thereby defeating the purpose of the flashing.

An Apparatus for Sterilizing Water by Heat

Boiling water in free air at 100° C. for about 20 min. will destroy all pathogenic bacteria and their spores, and will as a rule destroy all other bacteria, but cannot be counted upon to destroy the spores of the saprophytic bacteria, which will stand higher heat without losing their capacity for germination. To destroy all kinds of spores in water, it is necessary to maintain a temperature of from 115° to 120° C. A French firm has recently put on the market a small water sterilizing device for use in households, schools, hospitals, etc., which produces sterilization by the heating of the water under pressure to a temperature of 115° C. without causing boiling. If water is boiled in free air, the highest temperature reached is 100° C., which as stated above, is insufficient to kill all the spores. Furthermore, the boiling volatilizes some of the gases in the water and transforms or destroys the mineral salts, thus giving the water the familiar insipid taste noticed in the distilled product. The new French device remedies this trouble by producing the high temperature under pressure, thus preventing the boiling of the water.



A Section through Small Cartault Water Sterilizing Apparatus

(Heats water to 115° C. under pressure so that boiling is not produced)

In the accompanying figure is shown a section through one of the smaller machines which produces from 100 to 125 gal. of sterilized water per hour. The apparatus is composed of a cylindrical tank inclosing at its lower part a coil and topped by a small boiler which can be heated by a gas or alcohol burner. The raw water enters at the bottom of the cylinder and rises around the coils to the boiler, where it reaches the temperature of 115° C. It then rises over the tube at the top of the boiler and descends through the cooling coil to the bottom of the cylinder, whence it leaves to rise through an outside tube to the dischargic membrane shown in the upper left-portion of the view.

The boiler contains at its upper part a thermometric tube which is connected by an exterior tube to the corrugated metallic membrance shown in the upper left-hand of this cut. When the sterilization temperature is reached, the pressure in the thermometric tube rises and causes the corrugated membrane to expand, thus shutting off the discharge faucet valve. If the temperature rises, the membrane, increasing its expansion, opens the pocket and allows the water to be discharged. If the temperature lowers, this allows more cold water to enter the cylinder and reduces the temperature there, which in turn permits the membrane to rise and closes off the discharge faucet. If the heat for some reason is stopped, or the temperature of the water descends to 110° C., the membrane completely closes the discharge faucet.

A larger apparatus is employed in the schools of Paris, and has a discharge of some 600 gal. per hr. This is similar in its design except that the temperature control is connected to the gas flame and not to the discharge faucet. The company also makes portable sterilizers with a discharge of about 1000 gal. per hr. which, mounted on wheels and provided with gas engines and pumps, can be used for the service of troops in the field. It is stated that 1000 cu.ft. of gas are required for 3330 gal. of sterilized water, which, at $1 per thousand for gas, would make a cost of about $300 for a million gallons. As the device is intended to be installed where only very little water is used, such as in houses and in hospitals, the cost of the gas is practically negligible. We are not informed as to the price of the machine.

This apparatus is manufactured by the firm of Cartault, at 19 Rue Montmartre, Paris France. A description of some of the types of their machines appeared in *La Technique Sanitaire ed Municipale* for October, 1912.

Failure of an Earth and Timber Dam at Hamlin Lake, Mich.

A log and earth dam which backed up Big Sable River to form what is known as Hamlin Lake, about eight miles north of Ludington, Mich., went out on Oct. 18 and allowed most of the water of the lake to drain out into Lake Michigan, about a mile distant. No damage was done to property or person by the accident, but the draining of the lake left high and dry a number of summer cottages, piers, landings, etc., which had lined the banks. The indirect damage is thus very great.

Hamlin Lake, as raised by the dam, was about four miles long and ½ to 1½ miles wide, with an eastern arm about five miles long by ¼ to ½ mile wide. It has quite an extended reputation as a fishing resort, and several summer hotels and cottages, occupied principally by Chicago people, have been built along its shores.

The original dam was built in 1859 for the purpose of facilitating lumbering operations, and on its failure a second dam was built in 1887, but the latter held only one year. The present structure was begun in 1888, and since that time, with more or less constant repair, has maintained a head of about 12 to 13 ft. of water. No use was ever made of the water power, though a company was formed some three or four years ago, and began the construction of an electric-light and power line, but it is understood that this company became involved in litigation, and the project was abandoned.

Like its predecessors the dam was cheaply built of logs and earth. It had not been considered safe for some time. During the present season a concrete waste-way, with wing walls along a portion of the face of the dam, and concrete supports for the flood gates had been put in, and at the time of the break a small force of men with a steam pump were engaged in washing down sand from the banks above the dam, with the idea of raising the bottom of the pond and relieving the pressure on the face of the structure. The failure was undoubtedly caused by the gradual undermining of the dam by the leakage through or under it. The lake had also been unusually high all the season on account of the excessive rains.

The flood waters washed out a large channel between the dam and Lake Michigan, a distance of about one mile, but as the stream runs through unimproved land and sand dunes, no particular damage was caused. A part of the flow followed an old channel to the vicinity of Big Sable Point life-saving station, but was effectually checked by the sand dunes which had closed this outlet. Considerable of an old slab pier at the mouth of the river was washed out, and the Lake Michigan beach was strewn with débris from the dam.

The river channel is narrow with high banks for a few hundred feet above the location of the dam, and it required seven or eight days completely to lower the level of Hamlin Lake, which is now but little above that of Lake Michigan. Hamlin Lake proper is reduced to about one-half its former size, while the easterly arm, where much of the resort property is situated, is dry with the exception of a small stream which flows through its old channel.

The lumbering company which has been operating on the land adjacent to the lake states that the amount of future lumbering in the vicinity does not warrant the reconstruction of the dam. The owners of the adjacent property are naturally much concerned in the future of the dam, but they have not as yet completed any plans for financing the reconstruction.

We are indebted for this information to A. T. Brookins, Junior Engineer, U. S. Engineer Office, Grand Rapids, Mich.

The Largest Side-Wheel Steamer in the World

The 500-ft. paddle-wheel steamer for service on Lake Erie, which was mentioned in our issue of Oct. 17, was launched at the Wyandotte yard of the Detroit Shipbuilding Co., on Nov. 9, and was named the "See-and-Bee." It is for the Cleveland & Buffalo Transit Co., and will be put in service next summer between Cleveland and Buffalo. This run is about 175 miles, with a stretch of tortuous river channel at each port, but the time from pier to pier is to be about nine hours. In appearance the new boat is very similar to that of the 470-ft. steamer illustrated in the article mentioned above, but with the distinctive feature of a row of four smoke-stacks. The ship and its engines were designed by Frank E. Kirby, of Detroit, and we give below some further particulars of this interesting vessel, which is said to be the largest side-wheel steamer in the world.

Hull Construction

The steamer is 500 ft. long over all, 485 ft. between perpendiculars, 58 ft. beam, and 97 ft. 8 in. wide over the guards, with a molded depth of hull of 23 ft. 6 in. The hull is of steel, having a 3-ft. double bottom for water ballast extending for a length of about 365 ft. This double bottom is divided at the center line by a longitudinal water-tight girder, and is further subdivided by transverse bulkheads into 14 separate water-tight compartments. The hull above the water bottom is divided by 11 transverse water-tight bulkheads extending from the keel to the main deck. These bulkheads (with the exception of the collision bulkhead and others that are required by law to be without openings) are fitted with water-tight doors operated hydraulically from the engine room. Including the tank top, there are seven decks. Steel is said to be used to a greater extent in the structure of this ship than in any other of its type, being carried to the promenade deck.

Engines and Boilers

The propelling engine is of the inclined, three-cylinder compound jet-condensing type, installed in a compartment by itself immediately aft of the boilers. The estimated i.hp. is said to be 12,000 at 31 r.p.m., but the figure given us previously by the builders is 9500 hp. The high-pressure cylinder is 66 in. diameter and is placed between the two 96-in. low-pressure cylinders, all having a common piston stroke of 9 ft. The high-pressure cylinder is fitted with poppet valves and Sickles cutoff gear, while the low-pressure cylinders have Corliss valves and gear. The valves are all operated by the Walschaerts gear. This, in combination with the poppet gear on high-pressure and the Corliss gear on the low-pressure cylinders is unique in marine-engine design. The principal reason for adopting this gear was the desirability of having only one eccentric on the main shaft for each cylinder; there is also the advantage of short eccentric rods, and the links take up less head room. The cutoff in each cylinder has a range of 25 to 75%.

None of the cylinders are steam jacketed but, together with the two receivers, are well insulated. The pistons are of cast steel, conical, and of single thickness and are fitted with cast-iron spring and junk rings. The piston rods, crossheads, connecting-rods, guide struts and crankshaft are steel forgings. The crankshaft is 26¾ in. in diameter in the engine bearings and 30¾ in. at the outer bearings; it is 78 ft. 4 in. long from end to end, and weighs 120 tons. It is made in three sections, connected by flanged couplings which are recessed into the hubs of the crank arms. The crank arms are sunk into the pins, thus making the crankshaft perfectly rigid from end to end. The crankshaft and pins are hollow throughout. The connecting-rods are 21 ft. 2 in. long and 15 in. diameter at the middle; they are of nickel-steel, and each weighs approximately 12 tons. The piston rods are 12½ in. diameter. The two main air pumps, 62 in. diameter by 41½ in. stroke, are of the vertical, single-acting plunger and bucket type, driven through bell-crank levers from the low-pressure crossheads. Each air-pump crosshead also carries the plunger of a single-acting vertical feed pump, 8x41½ in. and bilge pump 7x41½ in. The condensers are built up of riveted plates and each low-pressure

cylinder connects with its own condenser through a 24-in. exhaust pipe.

The reversing of the engines is accomplished by means of a direct-acting steam gear, but a powerful hand-operated worm-reversing gear is fitted for emergency use. The main throttle valve, 18 in. diameter, is of the Schuette-Koerting balanced type, operated by a simple lever, and is fitted with an 8-in. "bypass" or maneuvering valve which is sufficiently large to operate the engine up to half speed. The paddle wheels are 32 ft. 9 in. outside diameter. The centers are of cast steel and the arms of forged iron with the large gudgeon bosses forged on and bushed with lignum vitæ. Each wheel is fitted with 11 curved steel buckets, 14 ft. 10 in. long by 5 ft. wide. The radius rods are of forged steel, with brass bushings.

Steam at 165 lb. pressure is supplied by six single-ended and three double-ended Scotch boilers. The single-ended boilers are made up of two shell plates and are 14 ft. inside diameter by 10 ft. 6 in. long; each contains two 54-in. furnaces and tubes 2¾ in. outside diameter. The double-ended boilers are made up of only four shell plates and are 14 ft. 2⅜ in. mean diameter by 20 ft. 5½ in. long, each containing four 54-in. Morrison furnaces and 2¾-in. tubes. The grates are all 5 ft. 6 in. long and designed for Howden draft. The boilers are placed in three batteries of three each, and are fired in fore-and-aft direction, the coal being carried in two large bunkers athwartship; this arrangement makes four distinct fire rooms. The bunkers are so placed that the coal is practically self-trimming onto the floors directly in front of the fires, practically eliminating coal passing. Bennett flue blowers are installed in all boilers. There are four smoke-stacks. The ashes are discharged outboard by eight hydraulic double-jet ash ejectors of improved design.

Electrical Equipment

There will be some 4500 lights on the ship, and numerous functions are electrically performed. The generating sets consist of three steam turbines directly connected to dynamos and located in the engine room on the main deck. The telephone system has a motor generator for calling and a central storage-battery for talking. There are over 500 telephones, including one in every stateroom. The steamer is equipped for wireless telegraphy and carries an auxiliary storage-battery plant which will operate for six hours if by any accident the generating plant should be put out of commission. An automatic signal board placed in the pilot house controls the signal lights of the ship. These lamps are carried in duplicate, one dormant and the other burning; if by any chance the burning light goes out, the other is automatically thrown in and registers in the pilot house. Assurance is therefore given that the signal lights are always burning, or that if anything is wrong with them it is immediately announced.

The steamer is equipped with an electric whistle device for sounding signals, and this is also arranged to automatically blow the fog signal at prescribed intervals. In addition to the usual engine telegraph, the means of communicating intelligence from the pilot house to the engine room include an electrical signal-bell system and also an electric indicator (connected with the main shaft) which indicates whether the engines are going forward or astern. The system of electric fans throughout the boat is very complete.

Ventilation

Great attention has been paid to the ventilation, and the ship is equipped with the McCreery Engineering Co's washed-air system of ventilation for all inside staterooms, dining rooms, buffet, smoke-room, galley and crew's spaces, and all lavatories and toilet rooms. It is divided into five units: one unit forward in the hold and another directly aft of the engine room will serve the two sections of the crew's quarters and the galley; one unit will supply the dining room, and two units on either side of the main deck will supply all the staterooms, the baggage room, the telephone room and second-class deck cabins. Each unit consists of a McCreery air-washer built of heavy sheet copper with brass pipe work. A Sirocco fan, directly connected to an electric motor, draws the air through a washer and distributes it through the duct work. The spray in the washer is maintained by a centrifugal pump direct connected to an electric motor. Throughout the crew's quarters and galley, adjustable elbows are used for distributing the air. In the staterooms, the air is introduced underneath the lower berths in such a manner and at such velocity that no draft is felt. The lower berth is kept about an inch from the wall so that the air flows directly upward entirely around both berths.

The heat generated in the galley and the foul air from the crew's quarters aft are removed by a large Sirocco fan located in the galley vent and connected to the spaces to be ventilated by means of ducts. Approximately 60 hp. (electric) is used for the ventilating system. The local vents from all the toilet fixtures throughout the ship are connected by means of ducts with aspirating tubes in two of the smoke-stacks, thus maintaining a positive exhaust of considerable suction on all these fixtures, so that no odors can escape into the ship.

Fire Protection

In addition to fireproof features of construction there is very complete equipment for fire protection and fire fighting. Fireproof doors are fitted in partitions extending from the main deck through all upper decks and divide the vessel into three separate compartments. In addition the boat is divided into 50 sections for fire-alarm purposes, each section containing about eight staterooms, and each room is connected to an automatic fire-alarm system with annunciators located in the engine room and in the captain's quarters. The grand stairway from the entrance hall to the saloon is inclosed in a vestibule fitted with sliding doors, so that it cannot form a shaft for the spread of fire from below to the upper decks. Steel fire curtains are fitted in the cargo spaces opposite the engine-room inclosures. Fire hydrants are located throughout the vessel, so spaced that 50 ft. of hose (connected at all times) reaches any part of the vessel. There is also a very complete automatic sprinkler system throughout the interior of the ship, covering all cargo holds, crew's spaces, hallways and cabins, smoking room, etc. This system is controlled automatically by a special sprinkler pump located in the engine room. When the vessel is at its dock, connections are made whereby city water is available for fire purposes.

Miscellaneous

There are two trimming tanks, each of about 52 tons capacity, located on both sides, just aft of the wheel casings. These can be either filled or emptied in from two to four minutes, thus making it possible to keep the vessel always on an even keel. To facilitate quick handling in rivers and harbors, the steamer is fitted with a bow rudder which is controlled by a steam-steering engine on the main deck forward. The stern rudder is controlled by a steam-steering engine, and emergency steam-steering gear is provided. The life-saving appliances will include 18 metallic lifeboats; 14 of these having capacity of 40 persons each, two having capacity for 20 persons each, and two for 16 persons each. In addition there is the usual number of life rafts and life preservers.

There are 424 regulation staterooms, 62 with private bath and toilet, and 24 parlor suites. There is sleeping accommodation for 1500 passengers, and the total carrying capacity is 6000 passengers and 1500 tons of freight.

Rapid-transit Subways are popular in Italian cities at the present time. Following the projecting of a large rapid-transit subway for Naples, a similar line has been elaborated for Genoa. The Genoa project is for a line about six miles long, of which three-fourths is in subway, and one-tenth on bridges or viaducts, the remainder being surface line. A related project is under consideration for Rome, where the plan is to build a suburban rapid-transit line to Ostia, of which something over a mile within the city would be in subway.

Handling the Smoke Problem in Chicago*

By Osborn Monnett†

The Chicago Smoke Department has adopted a policy of education in the methods of preventing smoke. Plant owners, enginemen and firemen are shown the proper method of constructing furnaces for various kinds of service and the best manner of handling the equipment they have. The problem in each plant is carefully investigated by the engineers of the Department, after which recommendations and suggestions are made to the owner as to the method of handling his plant or as to the reconstruction work necessary in order to operate within the smoke ordinance.

Sometimes entire boiler plants are rebuilt, and very often furnaces are reconstructed throughout. It sometimes happens that the operating crew finds it difficult to run a new plant without making objectionable smoke. The Department gives such a plant special attention until the cause of the trouble is known and changes have been made that will rectify matters.

There are a great many good furnaces on the market. The problem is to have the furnace and the boiler arrangements such as to give the best results, and the largest number of furnaces installed since the organization of the present Smoke Department have been designed especially for the plants in which they are used. It is aimed to get automatic stokers in all plants that are large enough to warrant the expenditure. It is the aim to get all plants under the best engineering conditions possible. A plant should be correctly designed, and built with due consideration given to all requirements for smokeless operation; and then it should be properly operated. *Proper operation is the most important thing of all, and in many cases the most difficult thing to obtain.*

A plant that violates the smoke ordinance at frequent intervals is given special attention. The engineers visit the plant and study the operation. After a thorough investigation of conditions, such as the fluctuation of load, and draft conditions, which would include breeching area, size of stack, gas passages through the boilers, etc., together with character of fuel, construction of furnace, and any other item which has any bearing upon the operation of the plant tending to produce or prevent smoke, has been taken into consideration, recommendations are made as to the best course to pursue in order to eliminate smoke.

In plants where considerable reconstruction is necessary, these visits often cover a period of several weeks, and even months, before the engineer is thoroughly familiar with all the difficulties and is in a position to make recommendations which, if followed, will necessitate the expenditure of considerable money. Owners and chief engineers of these plants sometimes think that the recommendations are far more sweeping than is necessary. In cases of this kind it is necessary to work with them and devise a scheme whereby such work as they do will be a benefit and a part of a general scheme of improvement to be executed step by step.

The Department has been subjected to considerable criticism for its activity in undertaking to advise people in trouble with regard to reconstruction work. In this connection it must be borne in mind that the purpose of the Department is to suppress smoke; that the public is looking to the Department to relieve it of the unnecessary air pollution caused by smoking chimneys, and that the Department must of necessity get action; otherwise it has no excuse for existing. Many cases illustrate the backwardness with which some proprietors attack the problem, and the reluctance with which they spend any money in trying to solve their difficulties. If the Department would allow this class of steam users to follow their inclinations, the city would never solve its smoke problem, as it is really the reconstruction jobs which are cleaning up the city.

Special Investigations

The smoke ordinance provides that only dense smoke is a violation. Dense smoke, according to the Ringlemann method, is No. 3 smoke or worse. If a plant makes continuous No. 2 smoke, the total amount of smoke made in a 10-hour run would be enormous, yet the plant would easily run within the ordinance and the matter could not be taken into court. The smoke density of such a plant would be 40%.

Another stack might violate the ordinance in seven minutes of continuous dense smoke, and be absolutely clear for the rest of the hour or the rest of the day, and the smoke density for the day would not figure more than 2% or 3%. Yet the second offender would be liable to prosecution, while the first offender (who was really making the most smoke) would go free. It was with this thought in mind that a system of Ringlemann chart observations was instituted during the past summer to ascertain whether the plants that were making the smoke, were actually violating the ordinance.

The Ringlemann chart method consists in reading the smoke density of a stack every 15 sec. for the period under observation. In this way we get a very close record of the behavior of the stack. The number of observations of Nos. 1, 2, 3, 4 and 5 smoke are tabulated and reduced to smoke units as follows:

70	units of No. 1	=	70
34	units of No. 2	=	68
100	units of No. 3	=	300
29	units of No. 4	=	116
146	units of No. 5	=	730
	Total		1284

As the readings were taken every 15 sec., this figure 1284 divided by four gives the smoke units for the period under observation, and as one unit represents 20% density, the calculation for density would be $(321 \times .20 \times 100) \div 170 = 37.7$. The Ringlemann chart reading shows not only the per cent. density of the smoke for the day, which is in fact the measure of the desirability or undesirability of the stack, but it also gives the number of violations per hour of the stack, if any.

Use of Records

The method of making use of this tabulated information is as follows: In working on, for instance, the clubs of the city, a copy of the chart is shown to the offender at the foot of the list and an appeal to his civic pride is made, which in most cases is sufficient to get satisfactory action. In approaching a factory which is making too much smoke, the Department first picks out a factory in the same line of business, which has as nearly as possible the same boiler equipment, and lays the facts before the offending corporation. For instance, that its factory is running, say 18% smoke density on a day's observation, while a competitor is running inside of 0.5% density, and that from the Smoke Department's standpoint there is no reason why the one factory cannot be run as clean as the other, provided they will put their plant in proper shape. This argument seldom fails to get the desired results without suit or threat of suit.

The information is of great value in combating claims of plant owners when they make the assertion that their plants do not smoke. One of the most common statements is that the owners do not believe the plant is smoking and that, compared with a similar line of industry, their stack is much better than their competitors.

Present Standards

The Smoke Department is holding every new plant to a standard of 2% smoke density on 10 hours' observation before issuing a certificate of operation, as provided in the ordinance. That this standard is not unreasonable, even in the hand-fired installations, may be realized when it is stated that with approximately 250 new plants which have been installed under permit since Jan. 1, 1912, practically all that have been

*Abstract of a paper read before the Western Society of Engineers (Chicago), Nov. 4, 1912.

†City Smoke Inspector, Chicago.

put in operation are able to show this low density on a Ringlemann chart. Those which do not show this density are studied with a view to improving conditions and no certificate is issued until this standard is reached.

Railway Smoke

The same plan of using the good performance of one company to spur others to better work is being pursued in the railway campaign. In 1910, readings were made showing the smoke conditions at the various railway centers, and a table showing the smoke standing of the railroads was prepared. In 1911 a similar set of figures was prepared. It soon became evident that there was an intense rivalry among the various roads in their efforts to be at the top of the list. This has been taken advantage of with good effect by the Smoke Department.

It has long been realized that railway smoke appeared heavier in summer than during the cold weather, but it was not known how much the weather affected smoke densities. Taking the smoke readings of the fall of 1911 as a criterion, and assuming the same effort on the part of the railroads to keep down smoke, the summer readings of 1912 show that there is approximately 100% difference in the smoke density of railroad smoke in the summer over the winter months.

By giving the smoke densities for various locations, a railway may find that its per cent. density at a certain point is very satisfactory, whereas at another point it is not at all satisfactory. By analyzing these reports for the various localities, the road is enabled to determine the points where its engines need special attention and to discover why it cannot have a uniform smoke density throughout the city.

The Present Status of Culebra Cut, Panama Canal*

On Oct. 1, the excavation required to complete the Culebra cut amounted, approximately, to 8,300,000 cu.yd., and the amount of material removed up to that date since work under American control began in 1904 was 85,400,000 cu.yd. Practically all the remaining excavation lies within a distance of 5 miles. The accompanying profile, Fig. 1, shows the distribution of excavation finished and unfinished between the dike across the cut at Gamboa and the Pedro Miguel locks.

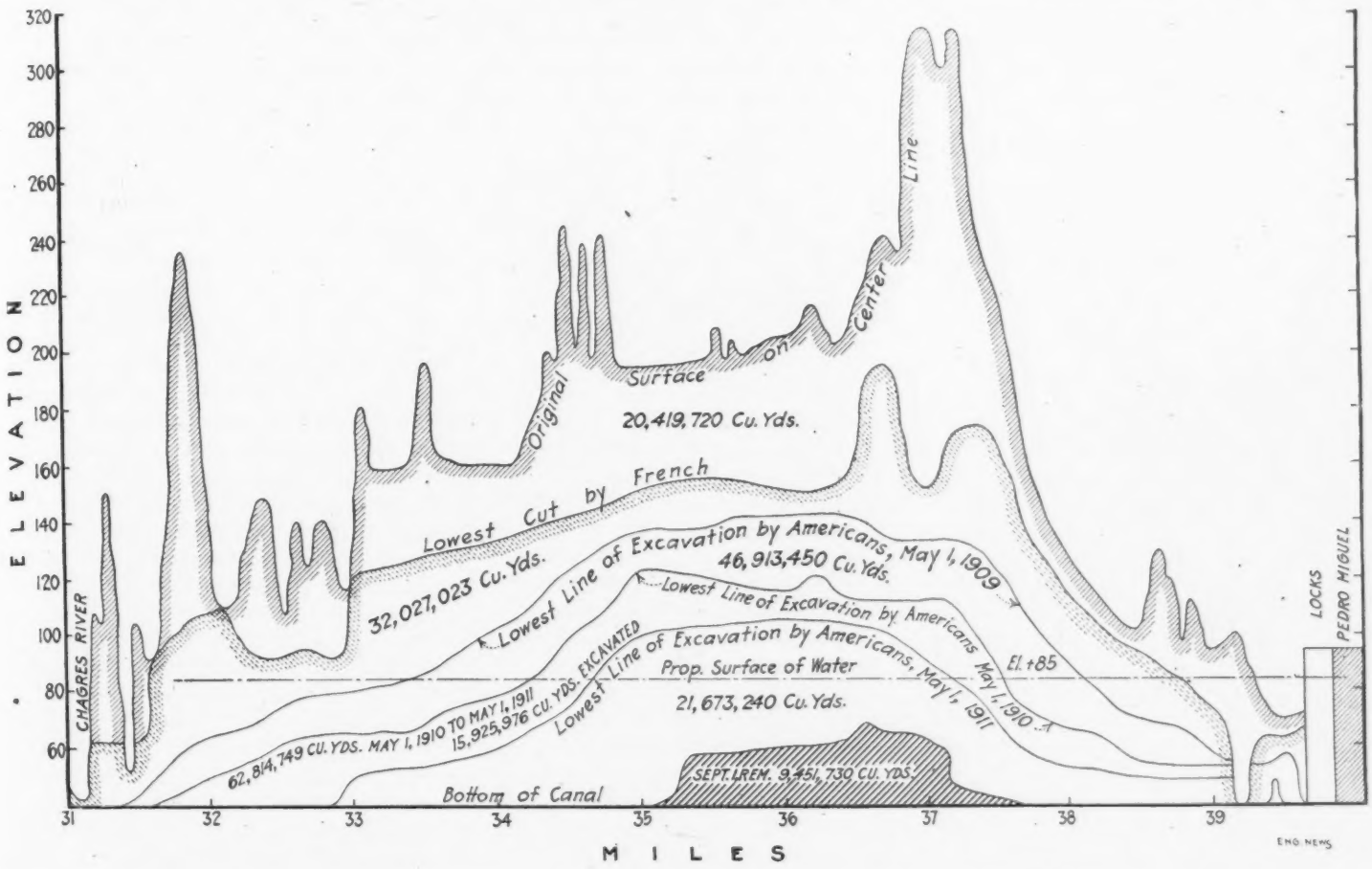


FIG. 1. PROFILE OF CULEBRA CUT FROM DIKE AT GAMBOA TO PEDRO MIGUEL LOCKS

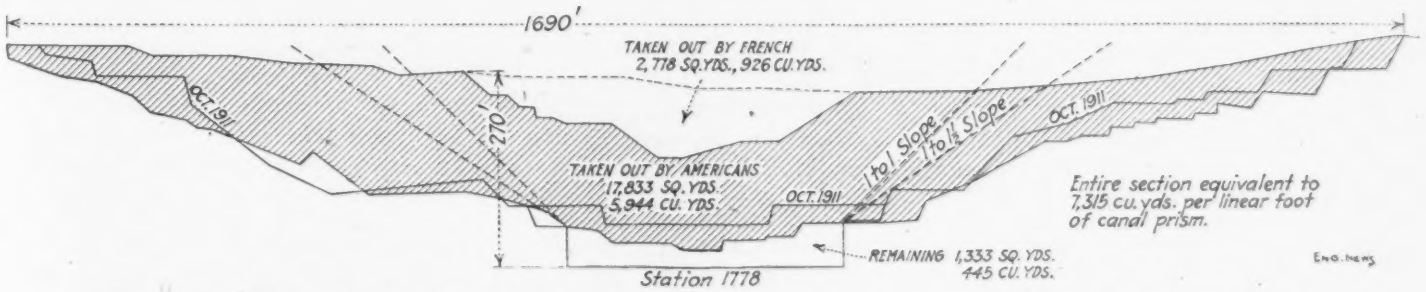


FIG. 2. CROSS-SECTION OF CULEBRA CUT, AT CULEBRA, AT POINT OF GREATEST WIDTH: EFFECT OF SLIDES

This profile of the elevations of the pioneer cuts is not a complete showing of the work remaining to be done, nor can these elevations be interpreted uni-

*Abstract from the "Canal Record," Oct. 2, 1912.

formly because of slides and breaks in the canal banks. Over twice the amount of material yet to be removed to complete the cut has already been taken out from slides, and about 45% of the excavation remaining to be done is due to them.

Fig. 2 shows a cross-section of the cut at Sta. 1778, opposite Culebra, where there are heavy slides on each side. It will be noted that the banks at this point have broken back until the width across the top is 1690 ft. Had the material allowed a continuous 1 on 1 slope the width would have been only 840 ft., with proportionate decrease in excavation. The result of slides is further indicated by the crossing of the lines showing the cross-section in October, 1911, and September, 1912.

Because the development and extent of slides cannot be accurately estimated, excavation in the cut will be prosecuted with vigor to allow for all contingencies. The number of steam shovels at work, which has averaged about 37 since the beginning of the rainy season, is shortly to be increased to 41 or 42. It is planned to have the dry excavation completed by July 1, 1913. Shortly after that date, water will be let into the cut through the dike at Gamboa, and the huge ladder dredge "Corozal" will be brought in from the Pacific entrance to work at the foot of any slides which continue to develop, in addition to removing the dike and cleaning out about 150,000 cu.yd. of silt in the completed channel between Gamboa and Mamei.

The slides call for no other treatment than unremitting excavation. The plan of excavating at the top, however, has reduced the size of the slides and restricted their menace. Following heavy rains on Sept. 21, 1912, the slides at Culebra, shown in Fig. 2, pushed out at the toes. One of them partly buried two steam shovels, and closed the pioneer cut for a distance of 50 ft.

Experience leads the engineers in charge to believe that if the tops of these slides had not been previously lightened by excavation, the movement would have been sufficient to bury all tracks and close the cut. Excavating at the top will be continued on all large slides.

The Fire in the London Post Office, on Aug. 24, 1912 (Eng. News, Aug. 29, 1912, p. 420), which so seriously crippled for a time the telegraph service to and from the British Isles, was not in the new reinforced-concrete building of the General Post Office, but in the old General Post Office, West, which is of ordinary stone and timber construction. The dispatches from England at the time stated that the fire was in the reinforced-concrete building and this statement was repeated in the note in Engineering News. Sir Henry Tanner, the head architect of H. M. Office of Works, states that the damage to the old structure was practically negligible, all the loss falling on the telegraph equipment.

A New Process of Timber Preservation

A system of preservative treatment for timber which has been in course of development for some years is now being introduced commercially and has been adopted already to some extent for the treatment of ties and bridge timbers. The information given below is condensed from a statement furnished to us by the inventor. The preservative material is melted paraffin with silica in suspension, combined with a certain percentage of naphthalene. This last causes expansion of the pores and ducts of the wood by reason of its volatile nature and sets up an active circulation, thus expelling the moisture and sap contents from the pores and ducts, and drawing in the preservative mixture. This mixture, upon cooling, forms a solid coating of all the interior ducts and pores. It does not leach out, it is impervious to water and all organic acids, and being also essentially antiseptic, it prevents the entrance of the spores which destroy the wood tissue and cause it to disintegrate and decay. The silica is a diatomaceous earth, so fine that 92% will pass through a screen of 40,000 mesh.

Wood so treated is claimed to be permeated by the preservative from circumference to center, regardless of the dimensions of the timber, and the process requires at the maximum only four hours as against 12 to 24 hours for creosoting. The material so treated is odorless. The treatment prevents checking and is claimed to add resilience to the timber, as well as render it immune to the attacks of the teredo and other marine borers, owing to the hardness of the contained silica. This last advantage is of value for the protection of piling, wharves, hulls of vessels and other marine construction. Another advantage claimed is that the treatment is completely successful with white oak and other hard woods which are impenetrable by other processes.

The treatment consists in immersing the timber for a maximum period of about four hours (but varying with the diameter of the timber) in the hot bath of melted paraffin, naphthalene and silica. The circulation system of the wood structure is utilized for the flow of the preservative in securing complete impregnation of the timber, and this is claimed as one of the special and distinctive features of the process. There is no complicated or costly machinery required, but only an open tank for the preservative, with suitable arrangements for heating by steam pipes or otherwise, and with facilities for handling the timber. The experimental plant consisted of a vertical cylindrical tank, just large enough to admit a tie, and jacketed to retain the heat furnished by a gasoline burner beneath the tank. This contained about 125 lb. of the preservative. The ties were dipped vertically, and were handled by block and tackle on a gallows frame.

The simplicity of the process renders it practicable to construct portable plants for the treatment of ties and other railway material at points of delivery and storage, while the farmer may be able to utilize the method in the preservation of posts, fencing, timber for buildings, etc.

It is stated that wood treated by this process does not become water-logged, no matter how deeply or how long it may be submerged in water. Spikes and nails hold better than in creosoted or even in untreated wood, and will not rust. Mortising and jointing can be done with safety because the complete penetration of the preservative protects the entire body of the wood.

The cost of the preservative materials used is very low, approximating 3c. per lb., and repeated tests have indicated that a small quantity per cubic foot will completely permeate the material treated, while a relatively smaller quantity will cause such partial penetration as might be desirable in a more economic use of the process. It is claimed that complete protection may be afforded by this method and material at a cost greatly below that of creosoting or any other known treatment.

Railway ties have been treated in a small experimental plant, and after an extended series of tests upon oaks and pines it was concluded that for complete impregnation the wood retained from 55 to 66 cu.in. (or 1.65 to 2 lb.) of solution per cu.ft., 33 cu.in. weighing 1 lb. Gum and ash require a larger quantity. The treatment seemed to remove all moisture and sap from the ducts, and oak which absorbed the above amount of solution did not permit the entrance of any water when subjected to hydrostatic pressure. Unseasoned timber is claimed to respond to the treatment as readily as seasoned. White-oak tie sections exposed to the weather in Virginia for nearly three years, and samples subjected to hothouse conditions, showed no indication of checking. Other samples have been exposed for seven years without being affected by decay. The Virginia Railway & Power Co. has adopted the process for its new suburban work at Richmond, Va., and for the bridge and tie work at Norfolk, Va. Other interests also are said to have adopted it.

The process is the invention of R. A. Marr, of Richmond, Va., formerly Professor of Engineering at the Virginia Polytechnic Institute. Patents covering this process were issued in April, 1912.

Forest Fires in the United States cost on an average $25,000,000 in property destroyed and a loss of 77 lives annually, according to a bulletin issued by the Forest Service.

Producing Sound Ingots*

By Sir Robert Hadfield†

In steelmaking, porous (unsound), piped, and segregated ingots are a fruitful source of defective material, for instance bad rails. Compressing the ingot during solidification has been used, but the method requires cumbersome machinery and is expensive. Hadfield's new method is very simple, and its cost should not be great.

*Abstract of a paper read before the Iron & Steel Institute, Oct. 1, 1912.

†Sheffield, England.

The question of producing sound steel is as important a factor in meeting the requirements of the time as ever it was. By sound steel is generally meant material free from (a) segregation, (b) blow-holes, and (c) piping. Unless these requisites are fulfilled, trouble and breakdown of the rolled or forged material produced from the ingots may occur in some stage of its history. Fortunately, as a rule, the remedy which obviates or overcomes any one of the difficulties tends to improve all. For example, steel which is sound and free from blow-holes is less liable to segregation or intermingled slag, and the ingots made therefrom, if properly fed, will have the piping largely reduced.

Many simple devices as well as complicated arrangements have been suggested and tried, to overcome the difficulties in question—as, for example, fluid compression from the top, also from the bottom; feeding the settling by gas-generated heat; compressing or squeezing from the sides; and many other devices which have given more or less satisfactory results. There are, however, some disadvantages in these systems—among others, the expense of application owing to the heavy cost of apparatus. For some years the author has been working at methods which appear to him to be simple yet efficient.

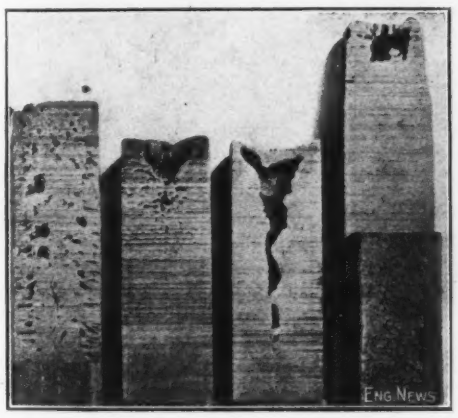


FIG. 1. GROUP OF 4-IN. INGOTS SHOWING EFFECT OF METHODS FOR ELIMINATING UNSOUNDNESS AND PIPING

(First ingot, without deoxidizing addition. Second ingot, with 0.036% aluminum addition. Third ingot, with 0.09% aluminum addition. Fourth ingot, with 0.09% aluminum and top-heating by Hadfield's method.

The chief object of this paper is to deal with this special method, as full descriptions of various other processes have already appeared in technical literature—that is, relating to the Whitworth, Harmet, Riemer, Illingworth, Robinson, and other processes. The ingots dealt with in the present paper are chiefly those of medium size, such as are used for rail production (varying from ½ ton to 2½ or 3 tons each, and from 8 in. or 10 in. to 20 in. or 24 in. square).

With piping steel the quality is raised, as regards greater soundness and less segregation. To get these full advantages it is necessary to have a method of properly feeding or filling up the settling which would otherwise be produced by steel having such piping tendencies. The author believes the method now described satisfactorily meets these requirements, both as regards improving the quality of the material and also cheapening production, by making an ingot which, by being sound, offers less waste.

At the Hecla Works, Sheffield, of the author's firm, large quantities of special steels are made, in which it is essential to have perfectly sound material. The method now described has enabled the desired object to be fulfilled, both cheaply and efficiently. Moreover, it has the important advantage of enabling not only soundness to be obtained, but also a much larger percentage of the ingot to be safely used. In many cases no less than 92% of the fluid steel in the mold is made utilizable, and this at small expense. Granted in the first instance, therefore, that we are dealing with sound piping or settling steel, which is easily obtainable by ordinary care in manufacture, there seems to be no reason why the ingots should not be sound, free from blow-holes, piping, and segregation. This being so, rails or other articles rolled from such ingots should be of the highest grade.

It is true that large quantities of rails as now made are of excellent quality, but it is just the "tenth" case which it is important to improve. It is the bad heat here and there, the bad ingot now and then, which gives the fatal rail which in service fails, involving catastrophe and all the troubles consequent upon such disasters. The methods described in this paper appear to offer a solution of this serious problem.

Fig. 1 shows the upper portion of four small ingots, each about 4 in. square and 30 in. in length, which were made to illustrate and test the question of soundness and piping. The first shows the steel as poured into the mold without any solidifying addition. This probably represents much current practice, for the reason that methods to take away the piping are at present not used, therefore piping steel is avoided. The author has been told by a railmaker abroad that he required steel which neither rose in the molds nor piped, a most difficult matter to accomplish in practice, besides theoretically incorrect. The second shows the same steel as used in the first, quieted by the addition of 0.036% of aluminum. This is still not altogether sound. The third had more aluminum added, 0.09%. The steel here is quite sound, but pipes deeply.

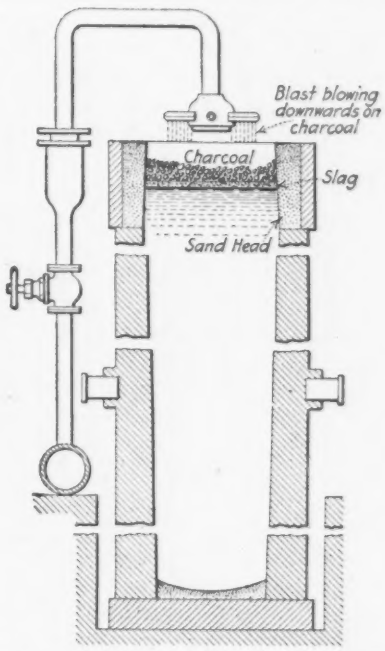


FIG. 2. ARRANGEMENT OF INGOT MOLD FOR HADFIELD'S TOP-HEATING METHOD OF PREVENTING PIPING

The ingot-maker appears, therefore, to be in a dilemma. If he makes his steel so that it will not settle, then it is unsound. If he makes it sound it pipes, and so is still not satisfactory, and there is much waste. To overcome this difficulty the methods described in this paper seem to be those best suited to give the desideratum of sound material from piping steel. Ingot No. 4, Fig. 1, represents the same steel of the sound type used for ingot No. 3, but furnished with the proper feeding top referred to in this paper. It will be noticed that the ingot is not only sound, but free from piping.

The object in many steel works seems to be to try and avoid a steel which pipes or settles. This really arises from the natural desire to avoid the trouble and expense of making preparations for dealing with piping steel. The desideratum, in the author's opinion, is piping steel, which should be properly fed.

The author's method of casting steel

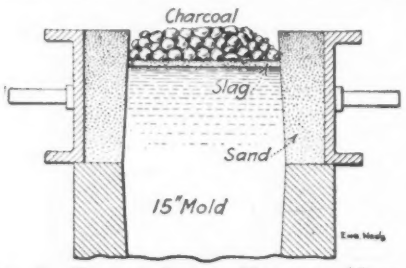


FIG. 3. TOP OF INGOT MOLD AS USED IN MAKING 15-IN INGOTS; HADFIELD'S METHOD

ingots, castings, etc., which insures soundness, freedom from piping, and absence of segregation, consists (see Figs. 2 and 3) in heating the fluid steel in the upper part of the ingot or other mold and maintaining it in a liquid condition by the combustion, in contact therewith or in close proximity thereto, during the cooling and shrinkage of the metal in the lower part of the mold, of solid fuel—for example, charcoal—by means of a blast of compressed air which is caused to impinge on the fuel while this is directly or indirectly supported by the metal below; and the interposition of a layer of fusible material, such as cupola slag, which has little or no injurious action on the metal, between the metal and the fuel. This slag largely prevents radiation of heat, the loss by which is much greater than ordinarily supposed to be the case. In Fig. 3 the upper portion shows the charcoal; then comes the layer of slag, about ½ in. in thickness. The lower portion represents the fluid steel in a 15-in. ingot mold. The sand or other suitable top to provide the feeding-head portion is also shown, inserted in the molding-box fixed on to the top of the ingot-mold itself.

While the ingots can be cast as at present—that is, large end down—this particular design shows the small end of the ingot downward. There is no doubt this is the better method, as by the small end forming the bottom portion, cooling takes place more quickly, causing the steel to congeal there and thus reduce the amount of feeding required later on from the upper portion of the mold.

The cost of carrying out the method is trifling compared with the large saving effected by reducing loss and waste of material. Moreover, the quality of the product is improved; for example, in making rails produced from such ingots, not only is there less discard, but the material is sounder. During the last few years many thousand tons of ingots have been made by this patented process, which has been found of great advantage.

As a specific example, it may be mentioned that ingots have been made, weighing about 5000 lb. each, in which the piping and discard do not amount to more than about 7%. This small loss is not the only advantage, the chief one being that material is obtained which is quite sound and free from hidden pipes or other defects in the whole length of the ingot. The system can be applied equally well to either smaller or larger ingots for all kinds of purposes, and for ordinary or special steels.

It is estimated that on a large output the saving by this method is about from $2 to $3 per ton. Thus, on a large tonnage, hundreds of thousands of tons annually, there would be a very considerable saving each year, as well as obtaining sound ingots free from blow-holes, piping, and segregation.

In this experiment even the segregation usually noticed was almost entirely absent, only a few inches below the feeding-head placed on the top of the ingot. At about 4 in. below the surface of the sinking-head the percentages of sulphur and phosphorus were practically the same as in the original steel—namely, about 0.03% each.

Two heats were made of mild steel and two of ordinary steel. In the former the carbon was 0.20%, silicon 0.40%, and manganese 0.60%; in the latter, carbon 0.45%, silicon 0.50%, and manganese 0.80%. The ingots were prepared in the manner described, that is, sufficient cupola or similar slag was placed upon the upper portion of the molten steel in the ingot mold, then charcoal, and blast applied by means of the special blowpipe arrangement shown in Fig. 2. Each ingot was provided with a sand top, placed at the top of its ordinary length of the cast-iron mold (Fig. 3). They were made in March, 1908. The results obtained are given in Tables I and II. The 14 ingots of each grade of steel

FIG. 4. SECTION OF 15-IN. INGOT TREATED BY HADFIELD'S METHOD

forged well in each case, and the billets produced therefrom were sound and satisfactory in other respects. With the exception of 8.8% and 7.9% waste, respectively (see Tables I and II), practically the whole of the remaining portion of the ingots represented salable and serviceable billets. The same results may be obtained with either small or large ingots.

Fig. 4 shows a 15-in. ingot broken, to show that the piping has been completely obviated, and that it does not

FIG. 5. HEAD OF 15-IN. INGOT, SHOWING UNPIPED METAL AT 8% DISCARD

FIG. 6. RAIL CROP, FROM PORTION JUST BELOW 8% HEAD DISCARD, SHOWING NO OPENINGS IN METAL

TABLE I. WASTE AND USABLE PRODUCT FROM 14 MILD-STEEL INGOTS

	Per Cent.
Head scrap	6.0
Billet scrap	1.0
Forge waste	1.8
125 billets	91.2
Total weight, 15,400 lb.	100.0%
Total waste	8.8%

TABLE II. WASTE AND USABLE PRODUCT FROM 14 MEDIUM-STEEL INGOTS

	Per Cent.
Head scrap	5.6
Billet scrap	0.7
Forge waste	1.6
126 billets	92.1
Total weight, 15,340 lb.	100.0%
Total waste	7.9%

"break out again," as is sometimes noticed when using other methods to avoid the troubles from piping.

Fig. 5 represents the head cut off a 15-in. ingot, showing sound fracture and practically no segregation. The head portion represents only 8% of the total weight of the ingot.

Fig. 6 is the rail discard, weighing 24 lb., from the portion immediately under the machined surface of the head, that is, from the most unfavorable portion. It will be seen that the rail is quite sound.

Although most of the results shown in this paper relate to ingots cast with the small end at the bottom of the ingot mold, there is no difficulty in applying the system to ingots cast in the manner generally practiced—that is, with the larger end at the bottom and the smaller end at the top of the mold.

A further experiment was made in which an ingot was cast generally in the manner described in this paper; but 9 min. after casting, the head portion was filled up with molten steel, and no air-blast or charcoal used. The result was unsatisfactory, showing that this method would not take the place of the one described in this paper. Another experiment was also made in order to ascertain the nature of an ingot using slag, but without the feeding device mentioned in this paper. The ingot was poured in the ordinary way, and a layer of fine-ground slag put on the top. No charcoal, and therefore no blast, was used. The ingot piped, and was excellent for soundness. The weight of the discard was, however, considerably greater, being about 12 to 14%. Moreover—and this is an important point—the segregated portions of the steel did not rise to the top of the ingot so freely. The material was impure, and segregated down to a much lower point.

As regards the time required for ingots to become set, it may be interesting to describe the following experiment carried out at the Hecla Works:

Ingots 9 in. and 18 in. square were cast. In the former case, a composition of 0.20% carbon and 1.25% manganese, was used; in the latter case, 0.40% carbon and 1.34% manganese. To determine the condition of the interior mass, a thin iron rod was inserted in the casting at short intervals after casting. The results, given in Table III, are interesting, and show the time required for fluid steel in ingots of this particular size to become "set."

TABLE III—PROGRESS OF SOLIDIFICATION OF TWO INGOTS

9-in. Ingot		18-in. Ingot	
Time after Casting min.	Distance Set up the Ingot from the Bottom in.	Time after Casting min.	Distance Set up the Ingot from the Bottom in.
5	4	25	6
10	6	40	13
18	40	55	55
22	45	60	58
	Complete solidification		Complete solidification

In conclusion, to sum up briefly the results of this research, it may be said that, in order to obtain sound rolled or forged products—for example, sound rails—there must first be sound steel in the ingots themselves. This means that it is necessary to use steel of piping nature; consequently the ingots from such piping steel must be properly fed. No doubt there are other suitable methods besides those described in this paper for obtaining such sound ingots, but it is doubtful whether these can favorably compare in simplicity, cheapness of operation, and in other respects.

Prerolled Pipeless Ingots*

By Benjamin Talbot†

Ingots made sound by aluminum or silicon are likely to pipe deeply. Talbot prevents the pipe from forming, by putting the ingot in the soaking pit very early, and then putting it in the rolls for a slight reduction, about 25%. An ingot so treated goes back to the soaking pit to solidify thoroughly before final rolling. Solid metal free from piping is obtained.

The process is the simplest yet offered for making solid ingots. It is to be patented.

*An address delivered Nov. 7, 1912, before a special meeting held at New York City in the rooms of the American Institute of Mining Engineers under the chairmanship of Charles Kirchhoff.

†Metallurgist, County Bank Chambers, Middlesbrough, England.

The problem of segregation and cavities in steel ingots is a subject which has given and is still giving metallurgists, engineers and operators matter for serious consideration. The question has come more into prominence lately in this country, from the desire of railroad engineers to secure a better rail than they have obtained in the past, as the service they now demand is increasing in severity. The rails here are as good as those made in other countries, but the conditions of service and the extremes of climate are more severe, and consequently more breakages occur.

MODERN FURNACE METHODS—Various reasons have been advanced as to why rails may not be as good in quality today as in the past. Some engineers consider that modern methods of manufacturing, designed chiefly to obtain large output, tend to reduce the standard of excellence of more deliberate methods. Others think that 4-ton ingots are worse than those of 2 tons. Again, it is stated that the 100-ton heat in one ladle is too large and is a step in the wrong direction in casting.

LARGE VS. SMALL INGOTS—My experience upon the question of the size of the ingot is that in rolling rails of 85- to 100-lb. sections, the range of ingot is only practically such that the difference in the size does not help in the question of segregation, cavities, or blow-holes. At Pencoyd, some 16 years ago, two bottom-poured ingots were cast at the same time from the same center runner, the one being 20x24 in. and the other 13x16 in. in size. The steel was acid open-hearth, the carbon being 0.43, phosphorus 0.062, sulphur 0.069. At the place where segregation generally concentrates I found: In the larger ingot 0.67 carbon, phosphorus 0.13, sulphur 0.18; in the smaller ingot 0.74 carbon, phosphorus 0.16, sulphur 0.27. Bottom-pouring at that time was considered better for surface defects, but the ingots showed blow-holes all up the surface, and the smaller ingot, in my opinion, was worse in every respect than its larger neighbor.

SIZE OF HEAT—The question of 100-ton ladle heats is an important matter. In my opinion this is distinctly a step in the wrong direction, as it puts a premium on careless and slovenly casting work. We find that, in order to empty a 100-ton ladle in the necessary time to prevent skulling, very large nozzles are used, probably as large as 2.5 in. in diameter. The pressure of this large quantity of steel rapidly enlarges the nozzle and it would be interesting to know what size the nozzle is when the last portion of the heat is poured. Anyway, large nozzles cause heavy washing up the sides of the molds and this gives surface defects. There is no doubt smaller ladle heats, poured with as small a nozzle as the heat will permit, give the most satisfactory results.

SOUND AND PIPELESS INGOTS—We now come to the question of producing sound steel ingots for the heavy trades. There are various methods, but we are forced to rule out the old and well known Whitworth and Harmet press, because of the cost of the process. Others, among whom is Sir Robert Hadfield, suggests the use of a sinkhead to feed the pipe which forms by the shrinkage of metal from its liquid to its solid state. To do this effectively some system of keeping the surface fluid must be adopted. There is no doubt that if this is carried out the sinkhead will feed the ingot and the cavity will be in the head. The question

to be decided with this method is whether it is commercially applicable to the large output required from a modern rail-mill.

MAKING STEEL SOUND—Sound ingots as regards the elimination of blow-holes are produced by means of the well known powerful deoxidizers aluminum, silicon, and ferrotitanium. All these deoxidizers have the same effect when used in the necessary varying quantities to produce this. They all produce solid steel, except for the large central cavity. They all diminish segregation. In my experience I have found with well made steel that an addition of 2 oz. Al to the ton is equal to 0.25% added silicon, and to 0.10% metallic titanium in the form of ferrotitanium. These additions will all produce the same characteristic central pipe, and if they are used this piped portion should be discarded in each case. If the rails are milled at each end, which gives a bright surface, as is the practice in England, the pipe is disclosed and the rail rejected by the inspectors. The cost of the aluminum addition is very small; with silicon it is considerable, and with ferrotitanium it is large, to obtain the same result.

If it were not for this large cavity, which may affect as much as 33% of the ingot, the use of these deoxidizers would improve the quality of the finished rail. It occurred to me that if we were to use a deoxidizer such as aluminum to eliminate blow-holes in the outer envelope of the ingot and then reduce the area of the ingot or the top portion while the center was liquid, the pipe would not form, and a solid mass would be found in the body of the squeezed ingot.

SOFT CENTER IN COMPRESSED INGOTS—In analyzing and taking sulphur prints off the face of the compressed ingot, which was cut longitudinally through its center, I came across an interesting discovery. I found that, whenever an ingot was compressed while its center was liquid, no segregation formed in the center of the upper part as is usual, but that it was driven to the internal face of the solid envelope in fairly regular percentage over the entire length of the liquid area. The solid outer envelope is the normal steel of the heat and is about 3 in., the carbon in this portion in this case being from 0.65 to 0.70. The carbon in the harder portion next this was from 0.75 to 0.80, and in the center about 0.50. The sulphur and phosphorus also vary in these strata, but as the phosphorus was low in this steel it was not of sufficient amount to be considered.

In ingots compressed while their center is liquid without the use of a deoxidizer, I find that the center shrinkage cavity is not formed, but that the blow-holes, which are found in the outer envelope, are not obliterated and can be traced into the rail. For this reason I prefer to use a deoxidizer so as not to have any surface blow-holes which tend to give spongy rails.

THE PREROLLING METHOD—The method of procedure is as follows: An ingot of at least 20x24 in. cross-section is used; 2 oz. of aluminum to the ton of steel is added to the ingot as it is being poured. Aluminum is preferred because of its low cost and its low melting point. It causes a perfectly solid outer envelope to be formed, and solidifies the metal earlier than if no deoxidizer were used. The ingot therefore can be stripped earlier, and it is then put into the soaking-pit to allow the envelope to become thicker, and at the same time have a proper temperature upon its surface for compression. A 20x24-in. ingot is reduced to about 18x18 in., and it is then returned to the soaking-pit for a proper heating and solidifying of the mass. After this has been accomplished, it is rolled down into a bloom, cropped and passed to the rail-mill.

The rail produced has the same characteristic formation as the squeezed ingot; viz. a hard working-face, harder ring at back of this, and softer center.

It is the question of this new formation that we manufacturers have to discuss with railroad engineers and metallurgists. If they accept this new structure with the guarantee that in this formation they have no pipe in a rail, then it will be for manufacturers to consider laying down the necessary preparatory plant to accomplish the liquid compression of the ingot, as it cannot be properly accomplished in any existing rail-mill without largely decreasing the output.

So far the rails produced by this method have been tested under the drop to the British standard specifications and they pass this satisfactorily.

The question of taking tensile tests out of the head has still to be considered, as these will vary as they do today according to the position selected. In fact, small tensile tests are unsatisfactory at the best, and it would appear that the only satisfactory method would be to have the testing-machine large enough to pull the full-sized head.

[The lecture was illustrated by a series of excellent photographs showing longitudinal sections of ingots both without and with aluminum addition, and both without and with the prerolling treatment. Photographs of sulphur prints of these ingot sections were also shown. Similarly there were photographs of cross-sections of rails rolled from these ingots, and sulphur prints of the rail sections.

The ingot sections made it clearly evident that the addition of aluminum produces a sound ingot, but one which is piped deeply; that the prerolling treatment eliminates the pipe, but does not affect the segregation or blow-holes; and that the combination of aluminum addition and prerolling does away both with blow-holes and with piping, giving an ingot section apparently entirely sound and free from all trace of pipe, requiring no discard except the slight cropping at the ends to square up.

The sulphur prints of the piped ingots showed, as is to be expected, a marked sulphur segregation in the neighborhood of the pipe. The ingots made with aluminum addition but without the prerolling treatment showed no distinct segregation, the metal even in the neighborhood of the pipe being quite clear of sulphur spots. This proved, what is well known, that the aluminum addition works against segregation. Finally, the sulphur prints of the fully treated ingots showed the peculiar phenomenon described in the address, namely, a long elliptical zone or shell of segregation area, a light low-sulphur and low-carbon interior (negative segregation), and a slightly darker outside layer outside of the segregated shell. This extreme outside layer is described by Mr. Talbot as being practically of the ladle-analysis composition.

The sections of rails rolled from the treated ingots showed thoroughly sound metal. The sulphur prints of the rails revealed a very interesting arrangement of the three portions of metal just described as being present in the ingot. The soft interior metal apparently formed practically the entire web and most of the base and extended up into the head as a small circular area just above the junction of web and head. The rest of the head was darker in color, with the darkest ring immediately surrounding the circular area of soft metal at the base of the head. The size of the soft circle differed slightly in different rail sections but in no case exceeded about half the depth of the head.

While we regret that we cannot show copies of these pictures in connection with the present text, we believe that the text itself makes the facts clearly enough apparent to be understood.

The last part of the address, calling attention to the structure of the prerolled ingots and of rails rolled from them, raises the definite question as to what opinion railway engineers hold concerning the serviceability of rails having this structure. Discussion of the address was requested by the chairman with a view particularly to bringing out opinions on this point. A very short abstract of the discussion from notes made at the meeting is given below.—ED.]

DISCUSSION

PROF. H. M. HOWE—Rolling is the cheapest method of compressing the ingot. The proposal made is so simple that many of us will wonder why we had never thought of it. The pictures of sul-

phur prints of ingots made by the process (showing a central body of material lower in carbon than the ladle test, surrounded by a shell of metal above normal in carbon, with a thin layer of practically normal metal at the outside) contain one point that is difficult to understand. In the production of this structure, carbon must have passed from the inside material to the intermediate layer, and this passage is almost impossible to understand. How many ingots are represented in the analysis given by the author? Are they more than a few individual ingots, which might be regarded as freaks?

H. D. HIBBARD—How many passes through the rolls are required?

B. TALBOT—Very few.

H. D. HIBBARD—The general plan proposed is not new. A number of patents on record from the nineties cover the rolling of ingots before the interior has fully solidified.

B. TALBOT—There is any number of patents on the subject. We do not roll the ingot to shape when the interior is still liquid. We don't want to roll green steel.

W. R. WEBSTER—When an ingot is rolled at too high a temperature it is apt to be torn internally. The tests made at Watertown Arsenal showed this clearly.

A. A. STEVENSON—We have repeatedly found cross cracks in the interior of metal rolled from the ingot too hot. Some time ago we had some blooms which, it developed, were rolled from the ingot at too high a temperature. They proved very troublesome and had to be rejected.

E. F. KENNEY—At Cambria we made a trial of Mr. Talbot's method as described by Dr. Stead [in a discussion before the Iron and Steel Institute recently]. The ingot was about 19x20 in. We left it in the soaking-pit 42 min., then rolled it to 18x18 in. Later it was rolled to 9x9 in. On cutting it apart we found openings in the metal, and we did not find the soft center shown by Mr. Talbot's sulphur prints. Another ingot of the same size and under the same treatment was rolled instead of to 18x18 down to 12x12 in., and at this point it split open and the soft inside metal squirted out.

P. H. DUDLEY—I do not understand how the low-carbon interior metal of Mr. Talbot's ingot comes to be there. On the New York Central we have for a number of years used ferrotitanium as a deoxidizer with great success, and the practice is now our standard. To get rid of the pipe we put the ingots into the soaking-pit just as rapidly as possible, before the pipe can form. As soon as the ingot can be stripped it is immediately set into the soaking-pit. When this procedure is followed out systematically, the pipe is entirely removed by a 12% discard. Sometimes, when the ingots are not handled fast enough, the discard runs up to nearly 20%, but with sufficiently rapid handling the formation of cavities in the top of the ingot is entirely eliminated.

W. C. CUSHING—From the standpoint of the users of steel rails, I am unable to form an opinion of what would be the effect of the soft interior. It would be interesting to try rails of this structure in the track. As a general matter, rails of distinctly heterogeneous structure are not looked upon with favor. In the worst rail failures a heterogeneous structure is found, although usually in this case the center is high in carbon (and impurities) rather than below the average of the ingot. Railway engineers are deeply interested in the question of sound ingots. I hope that steel manufacturers will make a thorough trial of Hadfield's, Talbot's, and Goldschmidt's methods, and inform railway engineers as to the results obtained.

M. H. WICKHORST—The low-carbon center of Mr. Talbot's ingot finds at least some analogy in the distribution of material in bessemer ingots as found in the ingot investigations of the American Railway Engineering Association. Here we found the lower half of the ingot to contain an area of negative segregation, that is, an area abnormally low in carbon. The area is pear-shaped, the point up, approximately half the height of the ingot from the bottom. Around this and in the middle of the top is a belt of positive segregation, and in the extreme upper and outer corners there are again small areas of negative segregation, and in these corners is found the lowest carbon of any part of the ingot.

GEORGE L. FOWLER—The outward shifting of the segregated impurities in Mr. Talbot's ingots may be produced by the churning action in the rolling.

BRADLEY STOUGHTON—As the ingot solidifies, its walls build up of crystals, whose axes point inward, these crystals growing toward the center as the ingot cools. There are pores or interspaces and cavities between the crystals. It is possible that in the prerolling used by Mr. Talbot the layers of crystals are forced together until they meet at the center, and the liquid residual steel high in impurities is forced outward into the cavities or spaces between the crystals. The sulphur prints shown contain some indications of an arrangement of the impurities to correspond with this theory.

A. A. STEVENSON—In service, rails rolled from ingots made under Mr. Talbot's method may develop a separation between the hard and the soft layers as a result of the rolling action of the wheels. A structure with hard exterior and softer interior was tried some years ago for steel tires for railway wheels, but with poor success, as the wheels developed shelling in service.

W. R. WEBSTER—The kind of heterogeneous structure referred to some time ago by R. W. Hunt as being injurious is that which has a soft outside and a hard center. Here the rolling effect of the wheels will cause the soft outside to be mashed and split on the hard center. Rails rolled from Mr. Talbot's ingot are of an opposite structure, having a hard outside and a soft center.

PROF. H. M. HOWE—These rails have a rather soft or normal outside, then a hard layer, and finally a soft center, which is not quite the inverse of Mr. Hunt's arrangement. The question is, is the hard ring of sufficient mass to act as an anvil?

B. TALBOT—The sulphur prints rather exaggerate the difference in composition of the different layers. The average amounts of carbon are 0.67% in the outside, 0.77% in the intermediate ring, and 0.50% in the central portion; this is not a great range of difference.

W. R. WALKER—The U. S. Steel Corporation will make a trial of Mr. Talbot's method.

Magnetic Hysteresis in the case of unsymmetrical magnetization cycle (i.e., where the magnetization in one direction has not the same value as in the other) was investigated by F. Holm, Berlin, Germany, as reported by him in "Zeitschrift des Vereines deutscher Ingenieure" of Oct. 26, 1912. He finds that for a given range of magnetization the hysteresis is very largely dependent on the absolute value of the induction at its upper limit, or, in other words, that the coefficient in Steinmetz's formula varies depending on the position of the magnetization cycle with respect to the zero line. His results did not prove adequate to establish a formula for the variation. Generally, however, he found a very large increase in hysteresis as the cycle was shifted upward in the early and middle stages of the magnetization curve. At extremely high values, however, there appears to be a decrease, that is, of two cycles of equal range embracing the extreme upper part of the magnetization curve the cycle of highest position is apt to have somewhat the smaller hysteresis loss.

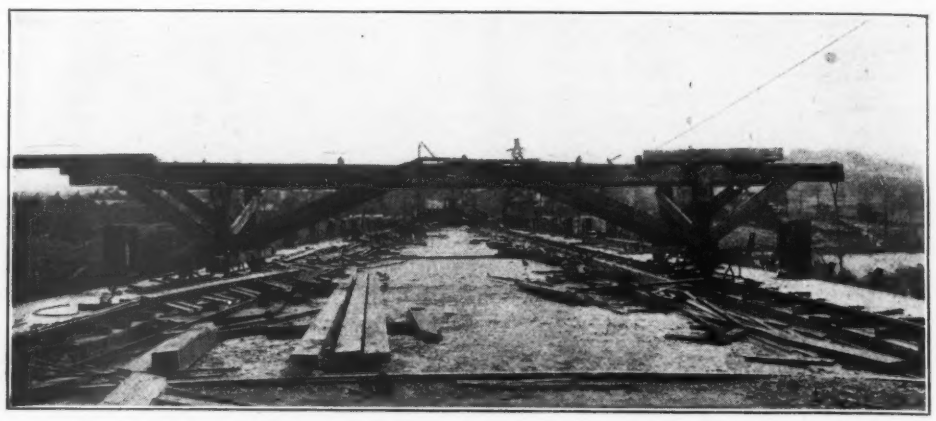
Diesel Engine Construction for marine service is summarized in the annual statement of "Lloyd's Register of British and Foreign Shipping," as follows:

At present there are being built under Lloyd's supervision Diesel engines for 34 vessels, 23 of which are of tonnages ranging from 2000 to 10,000 tons. These engines are of various types and range in power from 1750 to 120 brake-horsepower per set. Regarding the "Vulcanus," with four-stroke-cycle engines, it is stated that the results of the working have been so satisfactory to the owners that they have now under construction five other vessels of considerably larger size, and with engines of greater power, all to be fitted by the Nederlandsche Fabriek van Werktuigen en Spoorweg Materieel, of Amsterdam, at whose works there are being built, under the inspection of Lloyd's, 11 sets for six vessels of a collective power of 10,000 brake-horsepower. It is reported that during the voyages of the "Selandia" the engines "had given satisfaction, and needed only some minor repairs." The builders, Messrs. Burmeister & Wain, of Copenhagen (who also built the "Fiona," now named "Christian X"), have in course of construction similar engines for six twin-screw vessels, two of them being of higher power than the "Selandia," which was of 5000 tons.

FIELD AND OFFICE

A Gantry Support for Bridge Staging

The Larimer Ave. 300-ft. concrete arch bridge in Pittsburgh, Penn., which was completed this summer, has all its showing faces bush-hammered. As the deck of the bridge is about 110 ft. above the bottom of the valley it crosses, it was a problem how to provide convenient means of getting at the faces to do the bush-hammering. The device shown in the view herewith was gotten up by the contractor as a support from which to swing staging. It is a timber gantry of simple construction traveling on two rails, one laid over each curb. The projecting ends of the gantry top chords reach out over the side of the deck and allow staging to be hung from them. The scaffolds were raised or lowered by hand tackles just as are painters' scaffolds. The gantry shifted them along the bridge. The John F. Casey Co., of Pittsburgh, was contractor for the bridge. O. Stange was the contractor's superintendent.



GANTRY SUPPORT FOR SWINGING STAGING, LARIMER AVE. CONCRETE ARCH BRIDGE, PITTSBURGH, PENN.

(The exterior of this bridge is bushhammered all over. The scaffolds from which the work was done were hung from the projecting ends of this traveling gantry.)

Two Safety Devices for Tunnel Work

On a recent trip through a portion of the new pressure tunnels now being driven beneath New York City for the Catskill water-supply, two interesting devices were noticed, which have been installed as safety measures:

REINFORCED-CONCRETE DOOR—For storing the dynamite used for blasting in the tunnel, a dynamite room has been hollowed out of the solid rock, 250 ft. underground, and connected to the tunnel by a low, narrow passage, about 20 ft. long. At the end of this passage nearest the storeroom there is keyed into the rock walls a massive concrete frame, beveled at an angle of about 20°, to receive a heavy, reinforced-concrete door, similarly beveled, as shown in Fig. 1. This door is built up around five 15-in. I-beams, with reinforcing rods passing through and between them, and it swings on a 3-in. steel pin. It weighs 2 tons.

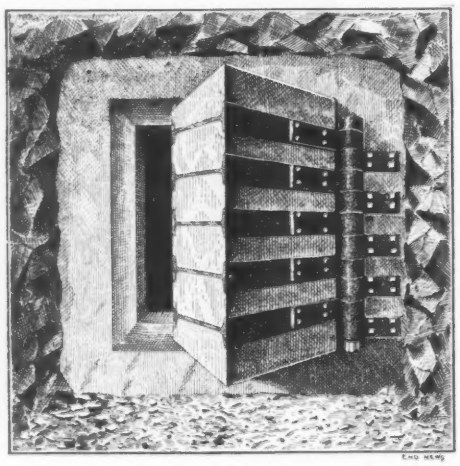


FIG. 1. A 2-TON REINFORCED CONCRETE DOOR IN THE CATSKILL AQUEDUCT TUNNEL

The door is arranged so that it can only open about two-thirds the full way, or to an angle of about 60° or 70° with the plane of the frame. Its objects are to reduce the force of the shock in the tunnel in case there should be an explosion of the stored dynamite, and to protect the dynamite chamber from excessive shocks from blasts in the tunnel, as in either case the door would be closed by the difference between the air pressures on the two sides.

The only disadvantage of the device is that frequently after blasting it has been necessary to open the door to the dynamite storeroom with crowbars in order to release workmen who were imprisoned in this room and could not get the door open themselves because of its weight.

AUTOMATIC DUMP-CAR STOP—The removal of excavated material from the tunnel is accomplished by means of dump cars which are loaded with the broken rock at the face of the cut and then hauled along a narrow-gage railway, by means of a storage-battery locomotive, to the shaft where they can run, one at a time, onto tracks on the floor of the hoist cage. This cage lifts a car to the surface, dumps it automatically and takes it back down to the tunnel.

Some difficulty was experienced for a while in having dump cars run off the end of the railway track into the pit, when the hoist cage was not at the bottom of the pit, and to prevent this nuisance the simple car-stop device, shown in Fig. 2, was installed.

As shown in the accompanying sketch, when the cage is out of the pit, the stopping device is held in position *A* by the spring at *C*, and cars can not run off the track into the pit. When the cage descends and is about to enter the pit, the lower end *A* of the angle-iron cam engages the stop lever at *A* and, as the cage continues to descend, the stop lever is forced over by the cam until the cage is at the bottom when the stop is in the position *B* and cars can pass from the cage to the track or *vice versa*, as may be desired. When the cage rises again, the spring *C* pulls the stop from position *B* back to position *A*, as fast as the cam will allow, and this again blocks the track.

Since the installation of this device there has been no further trouble with cars dropping into the sump at the foot of the shaft.

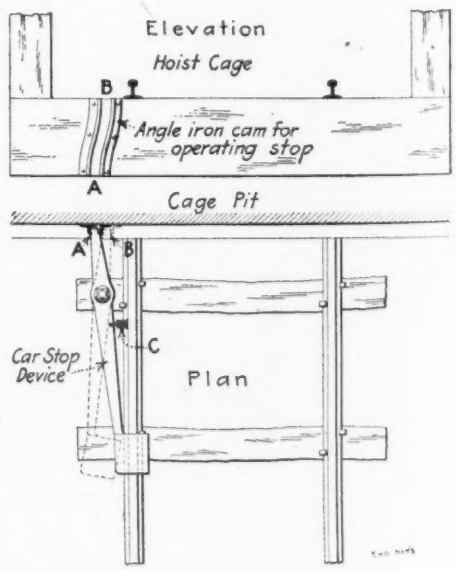


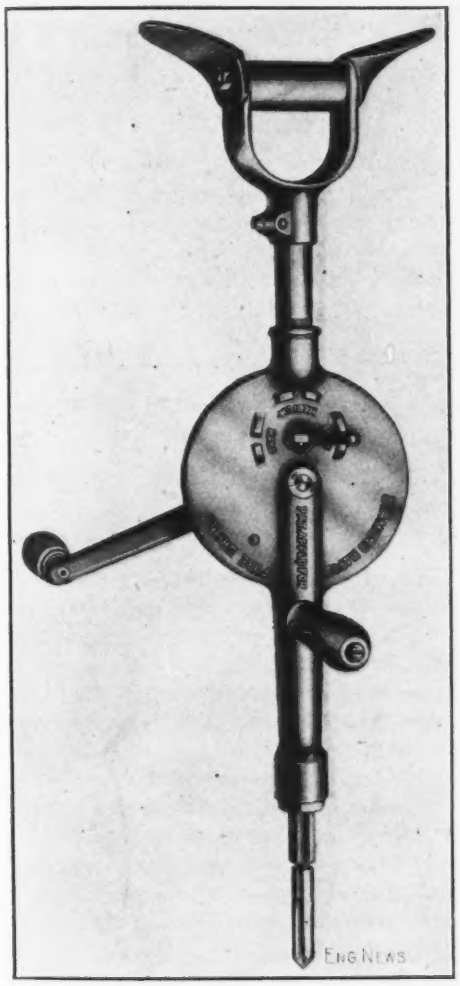
FIG. 2. AUTOMATIC DUMP-CAR STOP USED IN THE CATSKILL AQUEDUCT TUNNEL

A Hand-operated Percussion Rock Drill

There is being put on the market at the present time a new form of percussion drill, as shown in the accompanying cut, for use in making small and shallow holes in stone, brick and concrete, for stone bolts, wall hangers and similar purposes.

This tool hardly differs in external appearance from the ordinary breast drill, but there is no rotary motion of the drill point. The work is accomplished entirely by means of a rapid succession of blows on the head of the drill, produced from the rotary motion of the hand lever by a spring and tripping device.

The force of the blows on the drill



A Hand-Operated Percussion Rock Drill

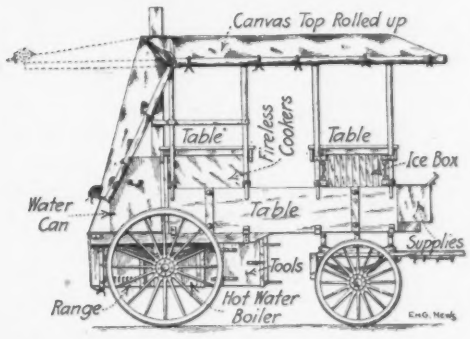
head in this machine is capable of six gradations, attained by means of two springs of different degrees of stiffness, and by means of a spring lever, arranged to produce in each spring three different degrees of initial tension. These possible gradations adapt the drill to use on a wide range of materials.

The set of drill points regularly furnished with this machine includes sizes from ¼ in. to 1 in. diameter in steps of ⅛ in. Special drill points up to 2 in. in diameter are furnished where desired. The shape of the drill point used is clearly brought out in the accompanying cut.

The points of advantage claimed for this device by the manufacturers, the Diamond Expansion Bolt Co., 90 West St., New York City, are that its construction eliminates vibration, irritating to the operator, that it is more economical of drill points, and that it allows of better work being done with less exertion and in less time than was possible with the old hand-drill-and-hammer method.

A Field Kitchen Wagon

Those who have had experience in feeding large numbers of people know that between 300 and 400 is the number which can be fed to the best advantage at one time. And it also happens by coincidence that this is the range in number of troops in the army tactical unit, the battalion.



Side View of the New Field Kitchen Wagon

These facts have been used by Captain Clarence F. True, Commissary, 71st Regiment, N. Y. N. G., as the basis for the organization of a new system for feeding soldiers in the field, which is more systematic, economical and reliable than the old company mess. The system and economy of the battalion mess is shown by the fact that it is carried on satisfactorily by a service corps of nine men, while under the older system five men from each company were required, or a total of 20 men for the battalion. The reliability of the new method is shown by the record it achieved under service conditions during the Connecticut Maneuvers in the summer of 1912. The 71st Regiment was the quickest and best fed among those participating, in spite of the fact that as part of the Red Army it was required to cover a large amount of ground, and make numerous quick changes of position.

The apparatus which made possible this improvement in the commissary work is the field-kitchen wagon, shown in the accompanying cut and described in the following paragraphs. Its simplicity is its most prominent characteristic and it seems incredible that some such outfit should not have been perfected years ago.

Equipped with a range, two fireless cookers, an ice box, a storage chest, and tanks for hot and cold water, this wagon also carries two kitchen tables, two service tables, a garbage can, a tool box and the kettles, pans, dippers and smaller utensils necessary to the preparation of a meal for three or four hundred men. This list looks formidable and suggests for the wagon the proportions of a moving van. However, the proper design and placing of the various elements has made it possible to put them all, without crowding, into a wagon 12 ft. long, 6 ft. wide and about 10 ft. high, and when packed there is accommodation on the wagon for the driver and three cooks, who can be busy preparing the next meal while the wagon is under way.

Economy of Careful Planning in Construction

By R. R. Raymond*

One of the first professional duties of the young engineer is apt to be directing the operation of moving earth to form an excavation or embankment. The actual operations involved are frequently of the simplest kind, so simple, indeed, that the beginner often fails to appreciate the great importance of studying the details and making his arrangements accordingly, in order that the final cost of the work may be as low as possible.

The following illustration of this point is taken from an old note-book and has been used in the instruction of students. It has so promptly fixed their attention and so convincingly pointed the desired moral that the writer ventures to submit it to the younger readers of Engineering News, in spite of its crudity and the obvious nature of the remedies adopted to meet the difficulties described below.

The work to be done consisted in borrowing 6000 cu.yd. of earth from a hillside and placing it in embankment to form the earthworks of a fortification. The estimated cost was 25c. per yd. On account of the small amount of work involved, it was desired to do the work with plant already on hand. A bright young graduate of a famous technical school was placed in charge.

The available plant included two large derricks already installed to cover practically the entire site of the embankment, a narrow-gage railway already laid from the borrow pit to the embankment, a locomotive, three flat-cars, nine dump boxes of 2 cu.yd. capacity each, and a number of scrapers, plows, etc.

After a few days of work, it was found that the cost was 80c. per cu.yd., and the determined efforts of the young engineer failed to better this figure. His troubles may be described briefly. He divided his

*Major, Corps of Engineers, U. S. Engineer Office at Wilmington, Del.

three cars into two trains, one having two cars and the other only one. At the borrow pit he had to maintain a force of teams with scrapers sufficient to load the two-car train carrying six boxes, or 12 cu.yd., during the time necessary for the one-car train to go to the embankment, unload and return. This force was wasteful when the one-car train of 6 cu.yd. was loading during the absence of the larger train. Also the unloading and spreading gang was trying to swing six boxes from the cars to the dump, spread and ram the earth, and send the empty train back, while the one-car train was loading. To accomplish this feat, the gang was made too large to unload the small train during the loading of the larger. All attempts at adjustment by the young engineer failed to solve the difficulties satisfactorily.

Now it is perfectly clear that the whole trouble lay in the lack of uniformity in the flow of material over the line. This idea was applied as follows: The cars were run singly; the borrow-pit gang was so reorganized that one car could be loaded with its 6 yd. during the time required to make a round trip over the road; the embankment gang was reorganized to unload and spread at the same rate; and both gangs were of the proper strength to do their work while the train crew moved one car over the line, dropping the arriving car and immediately coupling on to the waiting car, which was always ready to start at once.

The two gangs and the train crew worked smoothly and continuously. By careful supervision, watch in hand, it was possible to find the ideal organization of all gangs.

All of this is so simple that one hesitates to describe it. But what was the result? The cost of the work dropped at once to the estimated figure, and under favorable conditions to less than 20c.; and the ultimate saving, as compared with the cost obtained by the young engineer, amounted to twice the total original estimate.

Railway Work in Brazil*

I am at present engaged on the extension of the State of Bahia South Western Ry., which runs through the extensive cocoa-growing district of Bahia, the negro state of Brazil. The work is fraught with great difficulty, owing both to the nature of the country and to the scarcity of efficient laborers. The continual conflict of political parties also has a retarding influence on the work. The country, except where cleared for plantations of cocoa, is one dense forest, and the first work which has to be undertaken after the location surveys are completed is the clearing of this forest from the right-of-way.

The country is of a hilly nature, and the rainy season lasts about six months, during a great part of which time the work is held up, owing to floods and heavy rains. The formation is a heavy clayey soil overlying rock, which varies from a decomposed state to a hard solid granite. There is also much superficial rock, and it is a matter of common knowledge here that ground covered with masses of rock is the very best for cocoa-growing purposes.

Ties are obtained from local woods, the contractors having the choice of eight or nine varieties. We are installing a creosoting plant, in the hope that by this means we may be able to protect the ties against the attacks of the very varying climatic conditions.

The bridges are built with buttresses and piers of rubble masonry, with superstructures of steel, the latter being shipped from England. Sand and lime are obtainable locally, and portland cement is imported from England. The culverts are generally of a square type, with masonry walls, and concrete reinforced with expanded metal for the covering. The steepest gradient is 2½%, and the earthwork averages 8½ cu.m. per meter of line.

The labor is chiefly negro, and very bad. To do good work it is necessary to import labor. The negro will only work when he feels like it, and is very lacking in discipline. They have many saints' days during the year, on most of which they refuse to do a stroke of work. Broils and fights are frequent, often ending in loss of life.

The earthwork is let out to subcontractors, who each take on a kilometer or two, and are responsible for supplying their men with food, often making considerable profit out of this part of the business. The roads for getting about are practically impassable, making transport costly and difficult. They are nothing but huge ruts formed by the continual passage of pack mules. The rains come on, making them into pools of mud, into which your animal plants his feet, at each step often sending over you showers of mud. It takes just over an hour to ride 3 km., and walking is quite impossible.

There is room for hard-working civil engineers in Brazil, but they must be prepared to rough it and willing to learn the language, which is Portuguese. The salaries for qualified and experienced men vary from $1500 to $3500 per annum, with free quarters. Living costs about $1000 to $1250 per annum inclusive. There is work also for draftsmen, and they can generally get a salary of $1250 to $2000 per annum if experienced and capable. But in any case, I would not recommend anybody coming out to Brazil "on spec" unless he has sufficient means to support himself for two or three months.

*Abstract of a letter by Edward A. B. Willmer in the October issue of the "Journal" of the Junior Institution of Engineers, London, Eng.

A Flat-Filing Form of Railway Location and Similar Maps

By R. C. Hardman*

Maps showing railroad lines and rights-of-way, irrigation and drainage canals, highways and similar features which usually meander all over a sheet of paper can very easily be drawn in a form convenient and suitable for filing in a flat letter file or a book shelf. As ordinarily made, these maps are on large unwieldy sheets or, still worse, on a roll of paper or tracing cloth. The inconveniences of these forms are familiar to everyone. Especially is this inconvenience true of the roll form when one desires information contained in the middle of the roll or at the inside end of it.

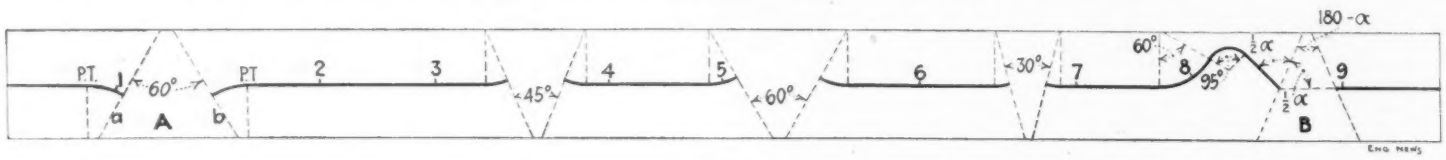


FIG. 1

The handy form referred to above is made on a strip of paper or tracing cloth 10 in. in width, which is a trifle less than the usual length of letter paper. This width may, of course, be varied to suit conditions. The length may be whatever is convenient or necessary.

The surveyed line is drawn along the center line of the strip, as nearly as possible. Changes in the direction of the line, whether made by angles or curves, are taken care of by breaking the continuity of the line by "breaking lines" having an angular divergence equal to the angle of the change in direction. This can be seen at *A* in Fig. 1, where the change in direction is made by means of a curve with a central angle of 60°, and the breaking lines are placed 60° from each other.

*Civil Engr. and Supt. of Construction, U. S. War Dept., Fort Huachuca, Ariz.

The foregoing applies only to changes in the direction of the line. In cases, as at *B*, Fig. 1, where there is no change in direction, but where there is a break in continuity in order to get the line back to its central position, the angular divergence of the breaking lines is equal to 180° minus the angle which the surveyed line makes with the center line of the strip of paper.

In plotting, the surveyed line is drawn, as stated above, along the center line of the strip until the first change in direction occurs (see Fig. 3). When this is reached the points of tangency and intersection (*a* and *b*, Fig. 3) are marked. From the point of tangency draw a perpendicular line and locate the center of the curve. From the center of the curve *c* draw a line through the point of intersection *b*, continuing it slightly beyond the limits of the strip.

From this point *d* draw another line back across the paper at an angle from the first line equal to the central angle of the curve. This, it will be seen, divides the curve equally. The breaking lines pass through the center of the curve, the middle of the arc and the point of intersection and meet beyond the limits of the paper, and are symmetrical with respect to the center line of the paper. The other half of the curve is then drawn.

At points as at *B*, Fig. 1, where there is no change in the direction of the line, the breaking lines are introduced to bring the surveyed line back to the center line of the paper, from whence it was taken by reverse curves which were so small that the continuity did not need to be broken. When this case arises, the tangent line is drawn until it intersects the center line of the paper. Through this intersection draw the breaking line bisecting the angle between the center line and the surveyed line. The second breaking line is then drawn at an angle of $180° - \alpha$ from the first, and the surveyed line continued from the point where it intersects the center line.

These processes are carried out wherever necessary to keep the line on the center line of the strip, preferably at each curve for the sake of neatness of appearance. The breaking lines should be dotted in, and contain between them all data relative to the curve, such as degree of curvature, central angle, etc.

When the line has been completely plotted, as in Fig. 1, the strip is creased along one breaking line of each pair and along the line bisecting the angle formed by the two breaking lines, so that the point *a* may be superimposed on the point *b*. By this means, the points *a* and *b* being coincident, the curve and the two adjacent tangents may be shown in their true relative positions. Fig. 2 shows the map in Fig. 1 after the creasing and folding of the breaking lines.

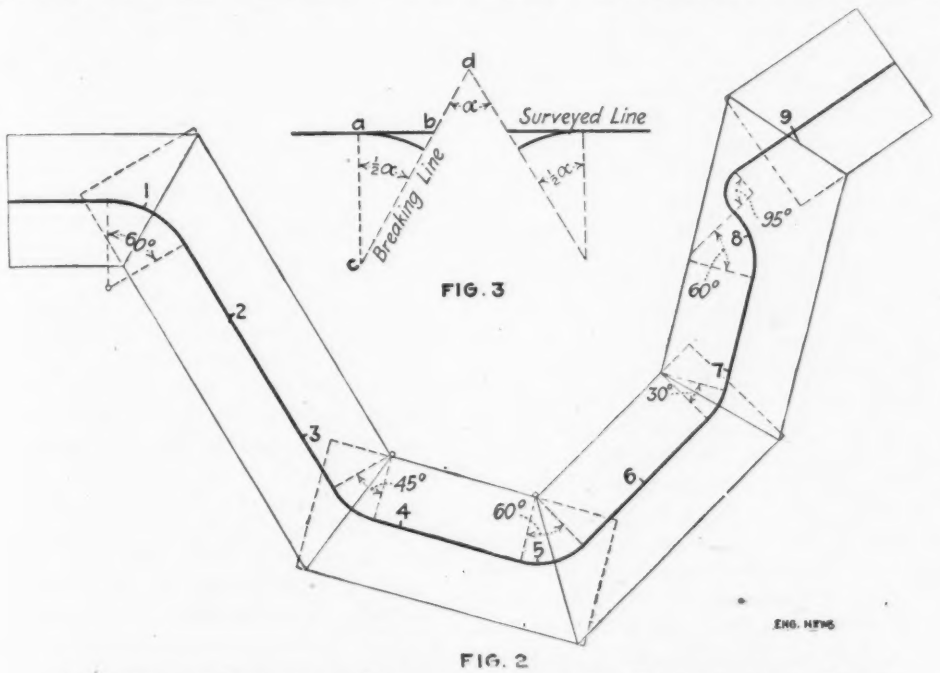


FIG. 3

FIG. 2

A METHOD OF PLOTTING A RAILWAY LOCATION FOR CONVENIENCE IN FILING AND HANDLING

For filing purposes this form of map is folded every 8 in., the folds alternating, that is, a "bellows" fold. A more desirable method is to cut the strip in sheets 8x10 in. and join them again by pasting a cloth strip on the back, so the fold can be made and used without injuring the paper.

When folded thus, it will be seen, the strip map makes a bellows folded book 8x10 in. in size—a size suitable for a flat filing system. A heavy cover or binding should be provided, to which the last fold of the map should be securely fastened. The book may now be indexed by small tabs so that any mile post or other distinguishing feature may be easily and readily located.

If any alterations become necessary on the map, the fold or folds containing the part to be altered may be removed and new ones inserted without damage to the map.

An advantage of this form of map, aside from its convenience and its suitability for filing in filing case or book shelf, is the small amount of paper necessary. For instance, the map as shown in Fig. 1 takes but one-fourth the paper required by the form as shown in Fig. 2, if plotted on a single sheet of paper.

Unskilled Labor

The change in the make-up and character of unskilled labor throughout the country during the past 25 years has brought with it a number of complications and difficulties. Decreased efficiency of labor, and the evils of the padrone system, are only two of the complications. While engineers and contractors generally have been familiar with the conditions and have had to deal with them in continually new form as circumstances of employment changed, yet there has only rarely been public discussion of the situation and of the best means of dealing with unskilled-labor forces under these conditions.

Recently the Roadmasters and Maintenance-of-Way Association had a committee report on the subject at its annual convention, Buffalo, Sept. 10 to 13, 1912. While this report concerns track-maintenance labor exclusively, it touches the interests of all who have to do with unskilled labor in other fields. The following represents some extracts from the report of the committee noted.

CHARACTER OF LABOR

Track labor has very materially deteriorated, both in intelligence and in efficiency. The cost of maintenance has gone up while efficiency has come down. Men of a class such as followed track work years ago are no longer to be found on sections or in extra gangs. Less robust and less intelligent foreigners have taken their places, and at the present time the element that composes the majority of our labor forces on American railways is made up of the races from southern Europe, of whom the Italians are probably in the majority. This is particularly true of the East and middle West. In addition we have the Japanese laborer on the Pacific slope, while the negro and the native white compose the labor forces of the South. It is plainly evident that we must depend almost entirely upon the foreigner for our source of labor supply for the present as well as the future.

METHODS OF SECURING MEN

Where it is possible to do so, the necessary labor force should be obtained locally by the roadmaster or foreman. If the required number cannot be secured

in this manner, the railway should maintain a labor bureau of its own at some central point where laborers assemble to seek employment. Let it be the policy of these railway labor bureaus to furnish free employment, free transportation, and, when necessary, send a company representative with the men to their destination and turn them over to the foreman for whom they were engaged, without any first cost to them either legitimate or extortionate. By this means the man so employed will realize that he is placed upon his own resources, and that upon his own individual energy will very materially depend how long he will be retained in the service.

Obtaining laborers through the regular employment agencies is not always satisfactory, due to the fact that through eagerness to secure a shipment of laborers and earn the fee connected therewith, the labor agent too often makes promises of various kinds that the local railway officials cannot fulfill. We are not in favor of hiring laborers through regular employment agencies except where it is impossible to secure them by the other two methods mentioned.

We are very much opposed to the method of obtaining laborers through such men as interpreters, book men, commissary men, etc., on promises of appointment as interpreters, subforemen, and timekeepers for the gang, or allowing boarding-house privileges for the purpose of furnishing meals and lodging to the laborers furnished. Usually the interpreter extorts a certain amount of money from each green foreigner for whom he secures work on his assurances of steady employment. He thus practically binds himself to keep these men at work regardless of their fitness or unfitness. The sole interest that the commissary man has in the labor he supplies is to extract every penny possible by charging exorbitant rates for provisions, which the laborers are compelled to purchase from him, and extortionate rents for small and unsanitary sleeping quarters. There is no hope of ever getting any satisfactory results under this system.

Caring for Men

Owing to the fact that conditions vary on different railroads and in different localities, the details of furnishing quarters for the men must be largely a matter governed by such conditions. For the average section gang, shanties of suitable size with good light and ventilation should be provided, with sleeping rooms separate from the living rooms, particularly if the men do their own cooking. All shanties should be furnished with necessary lamps and a heating or cook stove as the occasion demands.

The sanitary conditions are most important. Necessary toilets must be maintained. A foreman in charge should closely watch these things and insist that the buildings occupied and used by his men are at all times kept neat and clean, and that the grounds surrounding the building are also kept tidy. A great deal of the local prejudice against foreign labor is due to the filthy habits that on the surface seem to be general among the men.

Handling the Men

It is not an easy task to make good trackmen out of Italians, Japs, Greeks and Mexicans. It is still more difficult to teach men to speak and write the English language.

The first thing is to obtain the confidence of the men. Avoid abuse. Explain as clearly as possible just what is to be done. Make no promises that cannot be fulfilled. Allow full time for every moment worked. Give liberal allowances of time and proper food when working overtime in emergencies in stormy weather. Keep them always under submission by granting no concessions when a threat to quit accompanies the request. Teach them to become law-abiding citizens. Do not permit them to carry or possess any kind of dangerous weapon. Accustom them to the idea of keeping their home surroundings neat and sanitary. Explain how best to make purchases of clothing and provisions so that they won't be deceived by men of their own nationality who may have been somewhat shrewder than they and have started small stores for this purpose. Aid them to learn the English language by circulating the names of the various track tools and equipment they come in contact with every day. By such means as this, foremen can gain the confidence of their men and make them good and efficient trackmen in a short time.

Developing Foremen

Ordinarily on sections there are to be found several men in each gang who understand sufficient English to explain to the others just what the foreman wants. Where large gangs are employed and a man of the same nationality as the others is found capable of acting as a subforeman, he should be employed as such at a suitable increase in salary. The man so appointed should be given to understand that his retention in that capacity, and his possible advancement to the position of foreman later on, depend upon his success in getting the best results out of the men.

Some railways allow subforemen on some of the most important sections as a means of educating them for the position of foreman, at a slight increase in wages above that of the laborers, always selecting the most experienced man and the one who shows the strongest disposition to learn. We find that such foreigners make very good foremen, and in many instances get better results out of the men of their own nationality than do American foremen. They take part in the work with their men much more than do American foremen, who are loath to work alongside a gang of foreign laborers. One of the greatest drawbacks, however, in making foremen out of foreign laborers is their inability to read or write the English language.

There is no question but that there is local prejudice against foreign laborers. This can be overcome to a great extent by educating the men to endeavor to live as the average American does. They should be taught by example to be honest and truthful in all their dealings and to observe closely and to pattern after the general run of good American citizens. Give them to understand that this is a free country and that, as long as they conform strictly to its laws as other men do, and as long as they do not become a nuisance to the community in which they live, it is not necessary for them to pay a cent for the privilege of earning an honest living.

Storage-Battery Locomotives in Tunnel Excavation Work

Ten storage-battery hauling locomotives have been placed in service by the Holbrook, Cabot & Rollins Corporation of New York City, which has a contract for one of the sections of the Catskill water-supply distribution tunnels under New York City. These locomotives are for hauling cars of excavated material to the mouths of shafts which have been sunk approximately a mile apart. There are 10 tunnels having a total length of 21,000 ft. The rough bore diameters will be 13 and 14 ft., with finished dimensions of 11 and 12 ft.

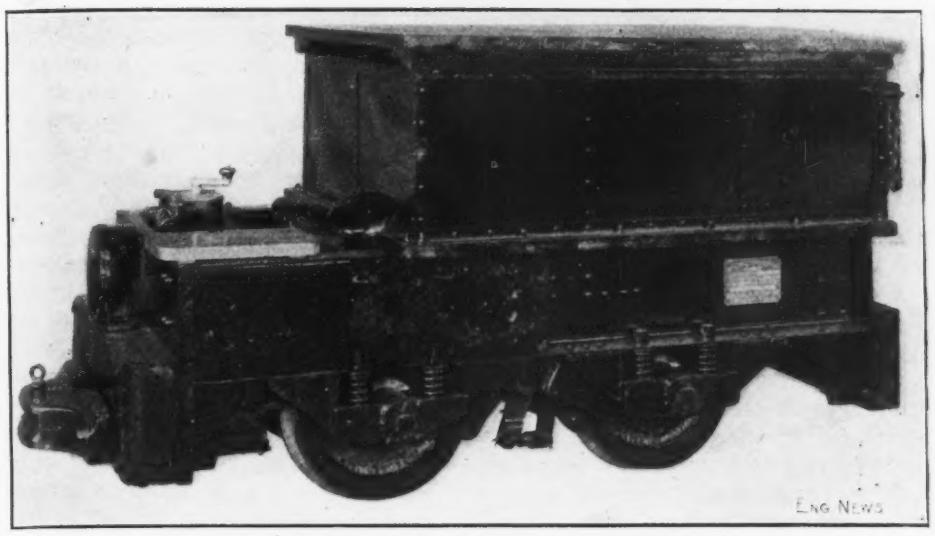
The type of locomotive is shown in the accompanying figure. It has a four-ton rating and can haul as many as four trailers. These ten units are claimed to be the pioneer storage-battery locomotives for hauling trailing loads in tunnels or mine work. Compressed-air locomotives were not seriously considered on account of the necessity of having six high-pressure charging plants. Oil-burning engines were not found feasible in the absence of definite information about the effects of gases given off.

The overhead-trolley system is often more advantageous, but in such small tunnels there are objections to the overhead wire and to bonding the rails. The following general dimensions are given for this design:

Diameter of wheels	20 in.
Wheel base	34 in.
Total weight	8000 lb.
Length over all	7 ft. 10½ in.
Height over batteries	49¾ in.
Track gage	24 in.
Speed at maximum tractive effort	3½ miles per hour.

The frame consists of two steel-channel sides and steel-plate ends, held together

From information furnished by the General Electric Co., Schenectady, N. Y., and Holbrook, Cabot & Rollins, 331 Madison Ave., New York City.



STORAGE-BATTERY TUNNEL HAULING LOCOMOTIVES

(Built for Holbrook, Cabot & Rollins Corporation, New York City, by the General Electric Co.)

with bolts and angles. Cast-steel pedestal jaws, to carry journal boxes, are bolted to the lower web of the channel side frames. The cast-steel journal boxes are fitted with roller bearings to reduce friction. The body weight is supported on the journal boxes through two coil springs at each box.

The wheels are pressed on and keyed to the axles. These axles are of a special grade of steel, case-hardened at the journals to reduce the wear at the roller bearing.

The motors are an automobile type, particularly designed for efficient operation on storage-battery service. Economy of current consumption is obtained by designing motors with a small air-gap between armature and field poles and by running the iron in the magnetic circuit at low magnetic densities. On account of this low density the speed-torque characteristics are steeper than in the ordinary railway motor, tending to limit the overload which can be thrown on the battery. The armature shaft rotates in ball bearings, and the motor cases are made dust- and moisture-proof. The motors are mounted in cast-steel suspension cradles, one side being supported on the axle bearings, and the other spring-suspended from the locomotive frame as in electric-railway practice. The motor drives the axles through double reduction gearing, there being an intermediate shaft, supported in the bearing housing cast integral with the suspension cradle.

The batteries, of the lead type, comprise 44 cells, and have a five-hour discharge capacity. The cells are grouped in four or more trays mounted on top of the locomotive frame in a sheet-iron case with wooden base and cover. To facilitate removal the battery trays are roller mounted.

Each locomotive has an ampere-hour meter, a headlight and gong. Two of these locomotives have been in service for over two months and the contractors have found the daily cost, repairs, etc., "surprisingly low."

Plotted Curves and Curve-Sheets

Curve drawing and the use of curve-sheets are becoming constantly more general and more important in all branches of the engineer's work. No doubt everyone who has many curve-sheets to prepare soon learns the chief rules of good practice which must be observed in this work. But these rules have never yet been written down in any text, and the beginner, therefore, has no guidance until he develops them for himself. At the same time, violations of sound principles in curve plotting come to notice often enough to indicate that even men of some experience do not consistently follow proper procedure.

In electrical curve-sheets, for example, where four or five or even more curves on a single sheet are often encountered, it is sometimes noticed that the same quantity appears as both abscissa and ordinate, being abcissa for one curve and ordinate for another. This is bound to be confusing, and since it is always avoidable it must be set down as bad practice; such an arrangement should never be used. Other cases are found where an arrangement that is permissible under some conditions is wrong under other conditions, by having a deceptive effect. Thus, a curve-sheet need not have its base-lines or zero-lines on the sheet, i.e., the graduation of either abscissas or ordinates or both may start from a value other than zero. But when the purpose is to illustrate the total variation of a quantity, say in percent of "normal" value, a true effect is obtained only when the zero-lines are the base-lines of the sheet, as otherwise the variation can appear so distorted that the reader is misled.

A few of the unwritten rules of good practice have been set down by Prof. E. B. Smith (Drexel Institute, Philadelphia, Penn.) in a paper published in the *Bulletin* of the Society for the Promotion of Engineering Education, 1912, No. 2. The following is abstracted from his paper:

The matter of the choice of an axis for particular quantities of values is largely determined by custom. The dependent variable is usually plotted as the ordinate (vertically), and the independent variable as the abscissa (horizontally). Most experimental work is accomplished by arbitrarily changing some quantity, which is then called the "independent" variable, and observing the effect upon some other more or less closely related quantity called the "dependent" variable. Unless there is some special reason for not doing so, the independent variable should be plotted horizontally and the dependent variable plotted vertically. One very important exception to this is in plotting curves in connection with tests of strength of materials. Here the independent variable (load) is plotted as ordinate, and the dependent variable (deformation or strain) as abscissa.*

Whenever designating the plot of a curve, it is usually done by such a phrase as "efficiency vs. speed," the abbreviation "vs." meaning "versus" or against. In other words, the dependent variable, efficiency, is to be plotted against the independent variable, speed. In speaking of a curve the dependent variable should always be named first, as above.

The proper choice of scale to be used on each axis in plotting a curve is of considerable importance in properly representing a law or result. Only by experience in curve plotting, and the knowledge of the principal laws of physics, is one able to choose the best scale for each axis. The scale need not be, and usually is not, the same on each axis. In general, the scale for either axis should be chosen such that: (a) The curve may be easily plotted and read; (b) the curve will cover as much of the sheet as possible; (c) the curve will not lie too close to either axis; (d) a particular part of a curve will be shown to an advantage; (e) the same axes will serve for plotting other curves on the same sheet; (f) the same axes may be used for other curves of different values, as in interposing curves for comparison and study of relation.

In plotting a curve each value or point should be carefully located and marked by some permanent mark. Most laws and experimental results are shown by a smooth, continuous curve, or a straight line. Most experimental data, however, are subject to so many conditions and variations, with more or less error, that points plotted will not of themselves form a smooth, uniform curve. Then it is necessary to draw such a curve, not through all the points, but in such a position that it will, as far as possible, represent an average of all the points. When the variables do not depend upon each other then the curve should usually be a broken line from one point to the next.

*The custom is correctly described, but there may be a proper question as to whether load is really the independent variable. A testing machine stretches or distorts the testpiece, and the stress is a measured result; thus, strain may be regarded as the independent variable, stress as the dependent.—Ed.

The paper also gives a number of specific rules, which we omit; some of them are of debatable validity. The instructions printed above, as well as the omitted rules, deal only with what may be classed as "simple" curve-sheets. Complex curve-sheets, as those comprising two sets of interrelated curves, are not treated.

For simple curve-sheets, as a general rule, it may be stated that a curve (or a curve-sheet) should be laid out and drawn in such a way that the information it covers is presented with accuracy and clearness; the essential data, scale, legend, and limit of validity of the curve, should be noted on the sheet; and the sheet should be so designed that the eye can take in the whole curve or group in one field of view.

A Uniform Map of the Earth's Surface in 1500 Sections

A map of the world, recently undertaken by agreement among the leading nations, is being prepared on the scale of 1 to 1,000,000—that is, 1 lin.in. on the map represents nearly 16 miles on the earth's surface.

The map is to consist of about 1500 sheets covering all the land areas of the world, each sheet representing 4° of latitude and 6° of longitude.

The sheets will be numbered according to a scheme covering the whole world, and the symbols indicating the natural features and the works of man will be uniform on all the sheets.

The sheets for the completed map would, if combined, cover an area about 150 ft. by 75 ft., or a globe 40 ft. in diameter; the United States portion would be about 16 ft. in width, a very large wall map.

The first sheet of the United States portion of this international map of the world has just been issued by the United States Geological Survey and includes Rhode Island and portions of New York, Connecticut, Massachusetts, New Hampshire, Maine and Nova Scotia.

The sheet just issued, which is numbered "North K 19" and known as the Boston sheet, is printed in six colors and shows all the principal cities and towns, railroads, main wagon roads, and other works of man, and the rivers, lakes, and other water features.

The different depths of the ocean are denoted by contour lines, or "depth curves," and various shades of blue, and the relief, or altitudes of all parts of the land surface, by contour lines and color gradations, from pale green to brown, a different tint being used for each 100 meters of altitude.

The Boston sheet is 24x25 in., and this will be the size of most of the United States sheets. The maps of areas at the far North covering 6° of longitude will, of course, be much narrower than those of areas covering 6° at the equator.

At the present rate of progress the United States portion of the international map should be finished within eight or ten years. It will be by far the best map of the country in existence.

The entire map of the United States will cost $20.80. Each sheet will cost 40c.

As a preliminary to the issuance of the completed color sections of the United States portion of the world's map the Survey is printing, in black and white, State maps on the scale of 1 to 500,000, being just four times as large as the world's map of the same area.

Already such maps have been finished and printed for Vermont, Illinois, Indiana, Iowa, Minnesota, Mississippi, and Georgia and a dozen others are in process of publication. These are sold by the Survey at varying prices according to the size of the maps. For instance, the Vermont map is sold at 10c. and the Minnesota map at 40c.

The colored Boston sheet (North K 19) of the world's map or any of the state maps mentioned can be procured from the Director of the United States Geological Survey, Washington, D. C.

There is, at present, no very accurate map of the United States as a whole, although the Geological Survey publishes a base map about 7 ft. in width and the General Land Office has issued a similar map. Most of the commercial maps are full of gross errors.

The Geological Survey has topographically mapped in great detail more than one-third of the United States, but these maps are mostly on a scale of 1 mile or 2 miles to the inch and are too large for ordinary comparative purposes.

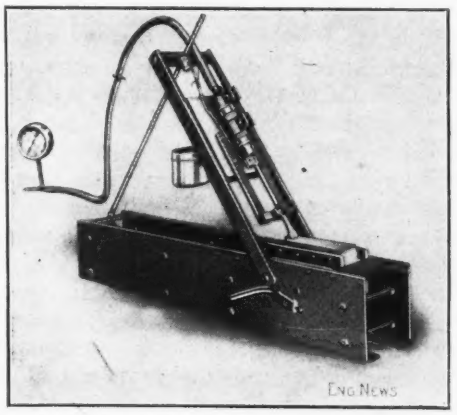
A Test for the Chiseling Resistance of Stone*

By Wm. A. Parks

The rate at which stone can be sawed is considered by some architects a good guide as to its behavior under the chisel. How true this may be in the case of a gang saw, I am unable to say, but it certainly does not hold in the case of the laboratory diamond saws, with which granite can be sawed with little less rapidity than some types of hard limestone. An attempt to obtain a set of figures for this report which would express the relative ease of chiseling of the Canadian stones led finally to the adoption of the apparatus described below [and shown by the adjoining halftone cut].

It must be distinctly understood, however, that the results given are the results obtained by this apparatus; how closely the figures approach the results that would be obtained in actual practice by the use of different types of tools at different angles and under different strokes must be left to judgment. To show that the figures obtained do not constitute a scientific scale, it may be mentioned that granite, under this instrument, possesses a chiseling factor of zero, which is absurd. Despite these objections the figures are relative for the conditions described and should be of value in deciding between the different stones tested.

The bed of the apparatus consists of two pieces of angle-iron securely bolted together and screwed down to a solid block of maple resting on a concrete floor. At the top of the angle-irons, planed guides are inserted which carry a traveling carriage. This carriage may be moved backward and forward by means of a crank actuating a series of cog wheels. The top of the carriage is provided with a longitudinal recess in



Apparatus for Testing the Chiseling Resistance of Stone

which a slab of stone may be securely fastened by a series of setscrews. Two stout uprights are fastened to the bed by a swivel joint and are firmly bolted together at the top. Between these uprights is placed a heavy block of steel which is capable of movement up and down on planed guides. This upright "back" can be set at any desired angle and securely clamped in position. To the face of the steel block is attached a pneumatic tool, the chisel of which is directed against the face of the slab of stone in the carriage. To prevent the binding of the chisel in the nose of the tool owing to the inclined bearing, it was found necessary to provide a guide for the chisel as near the cutting edge as possible. It was also found that the strokes of the hammer drove the chisel away from the anvil; to obviate this, springs were attached which held the chisel well up in the nose of the tool. After trying different types of chisels, one was chosen having a thin blade and a smooth cutting-edge, ¾ in. wide. The Barre, size A, pneumatic tool, was used,

*Extract from "Report on the Building and Ornamental Stones of Canada," Vol. I (Southern Ontario); Department of Mines, Ottawa, 1912.

and was operated at a pressure of 60 lb. per sq.in. The back was inclined at an angle of 54° 30′ from the bed, and the block carrying the tool was counterpoised so that the instrument bore down on the stone with a constant pressure of 12½ lb.

The test was made on strips of stone 2 in. wide and 1 in. thick, which were fastened by setscrews into the face of the traveling carriage. With the tool in operation, the chisel was allowed to come in contact with the stone, which was then moved forward against the chisel at the rate of 3 in. in 10 sec. The loss in weight which the slab of stone suffered in this operation represents the "chiseling factor" of the stone. The loss was ascertained in grams and the figures are here recorded directly as the chiseling factor of the stone.* In the case of limestones, there is a variation from 0.05 to 7.2; the sandstones vary from 0.0 to 5.6; the crystalline limestones from 0.2 to 5, and the granites from 0.0 to 0.5.

It is apparent that there are several possibilities of error in these determinations. In the first place, it is difficult to obtain chisels of exactly the same temper and to sharpen them for each operation in exactly the same manner. Further, a fine edge will produce the highest results with soft stones, while a blunter edge is more efficacious with hard stones. In making the tests a fine edge was used throughout, so that the results are probably low for the harder materials, as the first few blows turned the edge and diminished the cutting power of the tool. The reduction of the "chiseling factor" to dollars and cents must be left to the builder who knows by experience what it costs to prepare any given form from at least some of the stones here enumerated.

A Philippine Civil Service Examination

A correspondent sends us the following questions, an example of the examination given for civil engineer in the Philippine Civil Service:

Experience

Weight 30%. Based on a statement inclosed with the application for examination.

Mathematics

Weight 20%. Time allowed, 6 hours. Answer all the first three questions.

1. Derive the formulas for obtaining the horizontal distance to, and the elevation of a point by an inclined stadia sight.
2. An open traverse a, b, c, d was run on azimuth as follows: a-b 47°20′, b-c 135°15′, c-d 93°10′, with distances 1136.4 ft., 826.8 ft., and 482.6 ft., respectively. Find the az muth and length of d-a.
3. A line was run tangent to the 55th parallel. Assuming the earth to be a sphere 7920 miles in diameter, find the offset in feet from the tangent to the 55th parallel at a point 6 miles from the point of tangency.

* For all stones examined in the reconnaisance with which the report deals, the "chiseling factor" is given in connection with the other qualities such as specific gravity, permeability, strength, loss in freezing, etc.—Ed.

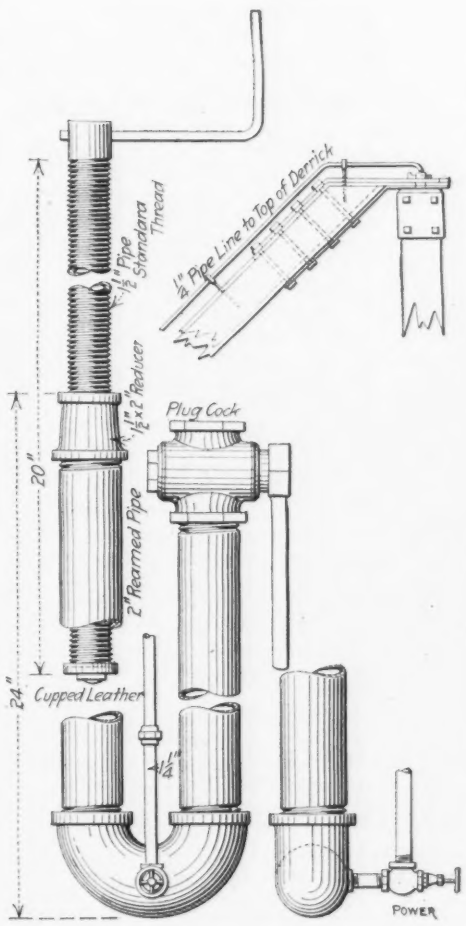


FIG. 1. MASTHEAD OILER

Work one only of the following two problems.

4. Given Q equal to $117v\sqrt{RS}$, find the discharge in cu.ft. per minute of a pipe 2 ft. in diameter running 18 in. deep if the slope is one inch in 200 ft.
5. A floor is supported by 6x12-in. wooden beams 2 ft. 6 in. on centers, 20 ft. span. How deep may material weighing 50 lb. per cu.ft. be spread uniformly on the floor if the fiber stress is not to exceed 800 lb. per sq.in?

Surveying

Weight 25%. Time for surveying and design 9 hours. Answer any six questions.

1. Explain how you would make a complete hydrographic survey of a tidal stream about 10 miles long and varying in width from 300 ft. to a half mile.
2. Name the field adjustments of an engineer's transit in their proper order, and explain in detail the collimation adjustment.
3. Describe the sextant and explain the geometry involved in its construction.
4. How would you lay down 2-ft. contours over an area from 5 to 10 sq.mi. in an irregular country with a variation of 300 ft. in elevation?
5. Explain the method of adjusting a closed traverse.
6. Explain the method you would use to make a continuous profile to get excellent results.
7. Name the methods you know for determination of latitude and explain the one you prefer.

Design and Construction

Weight 25%. Answer any four questions.

1. Name the defects of either yellow pine or lawan, and explain method of detecting.
2. Design a steel highway bridge from 45 to 50 ft. span for ordinary highway traffic.
3. Name and explain the sufficient tests for portland cement.
4. Design a double riveted butt joint to resist a tension of 120,000 lb. The allowable stress in the metal to be 15,000 lb. per sq.in. and 12,000 lb. per square inch in the rivets.
5. Design a reinforced concrete beam for a span of 25 ft., to carry a load of 500 lb. per ft., using 1:2:5: concrete.

Notes

Derrick Safety Devices—R. Reddie describes two safety devices for the protection of derrick operators in "Power," of Nov. 19, as follows:

Two of the most prolific causes of injury and death to the operator of a derrick-hoist are a fall when climbing the back-leg to oil the mast-head pin; or being hit by the loose end of a broken rope as it comes lashing into the engine house.

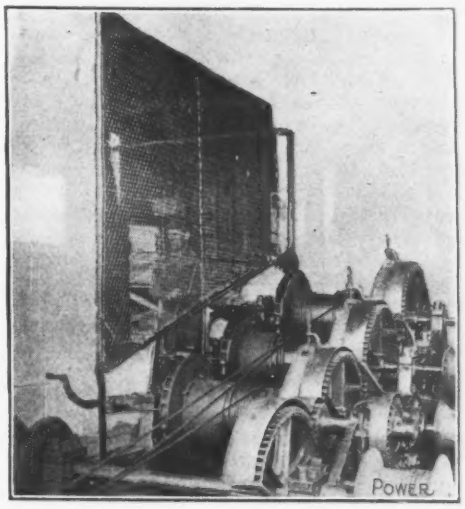


FIG. 2. ENGINE-ROOM SCREEN

Fig. 1 shows a black-oil force-feed oiler which is attached at the ground level to a back-leg of a derrick. A ¼-in. pipe leads up the back-leg to the mast-head and is held in place thereon by spikes as shown. The oiler is filled through the plug cock by running the plunger back above the top level. The ¼-in. globe valve is kept closed except when forcing oil to the mast-head.

Fig. 2 shows a screen between the engineer and the drums of his engine, and is self-explanatory.

Passing a Cave-in in Tunneling by sinking a shaft over the cave-in was done on the Wepawaug River water-supply tunnel of the New Haven Water Co., completed last year. This tunnel lies a short distance west of New Haven, Conn. It is of 6½-ft. circular section, on a grade of 1 in 2500, and comprises two parts, one 6,664 ft. long east of Race Brook Valley, crossing under Trout Brook, and the other 1729 ft. long from the west slope of Race Brook Valley to the valley of the Wepawaug River. The longer section of the tunnel was driven from the portals and from two intermediate shafts, one of which was on the west bank of Trout Brook. When the east heading from the latter shaft was 260 ft. in, and was directly under Trout Brook, a break-in of the heading occurred with an inrush of water and quicksand which engulfed four men and completely filled the tunnel. In order to carry the tunnel past the break, a shaft was sunk from the surface directly over the break. This shaft, 10 ft. wide and 25 ft. long, was formed by excavating inside of 3x8-in. t. & g. sheathing in 16-ft. lengths driven down to rock by an air hammer. No difficulty was experienced in passing the cave-in by this procedure.

Subsequently a portion of the tunnel west of the point of the cave-in was lined, on account of the lack of permanence of the rock, and ultimately the greater part of the tunnel, a total of 5900 ft., was lined with concrete. The

cross-section inside the lining is 5 ft. wide by 5½ ft. high, with three-centered arch and nearly flat invert arch.

The closure of the heading survey lines of the different sections of this tunnel was made with discrepancies of ¼ in. to 2½ in. in alinement and ⅛ to ½ in. in elevation. The tunnel was completed in 1911. C. M. Blair, Engineer-in-Charge, described the works and their construction before the Connecticut Society of Civil Engineers ("Proceedings" 1912).

Pavement Records—A common cause of ruin of city pavements is the constant opening up of stretches for one reason or another. While every city probably has a record showing when certain pavements were laid and other data on construction, perhaps few keep a history of the pavement giving all the details in respect to the vicissitudes it undergoes from openings for sewer and water connections, gas, telephone and electric light conduits, etc. Such a record is kept by the city of Grand Forks, N. D., on "Paving Plats," described by City Engineer H. G. Lykken in a recent report as follows:

Canvas-backed plats of each street intersection of the pavement on sheets 36 x40 in. show all details of the construction of the pavement and the drainage. When any opening is made in a paved street the location is accurately platted, and a record made on the plat of when and why such opening is made, when repaired, and the name of the parties responsible. A complete record of cuts through the pavement and the repair of same is made on these sheets.

The city has over a quarter of a million square yards of pavements of seven different varieties. Under the city charter the property owners in each paving district have the sole right to designate the kind of pavement to be laid. The engineering cost, including inspection, for paving work during the past two years at Grand Forks has averaged 1¾% of the contract price.

Black-Line Reproductions of Tracings may be made as follows:

A blueprint is made, using a very slow paper, the chemical coating on which is slightly different from that in general use. This print is not washed, but is placed face downward on a sensitized gelatine plate and an ordinary gum roller is run over it. The paper is then removed having in this short time etched a negative on the gelatine. If any dirty spots appear on the plate they are removed by a wet sponge. This plate is then inked with a special printer's ink from a gum roller, only the etched portions taking the ink. A print is obtained by placing the paper or cloth over the plate and running a roller over it. To make duplicate prints, no further work is necessary than to re-ink for each impression. There is no distortion, and while a Van Dyke print shows brown lines on a somewhat discolored background, the black print above described can be made on any material, and gives good black lines on a clean background, which allows the making of additions in ink without changing the general appearance of the print. In the Van Dyke process the lines of the print are in the paper itself, while the lines of the black print are printed on the surface of the paper and can be removed with an eraser. A field office may at different times need blueprints of a tracing that is in the general office and for that purpose a blackline print on a thin strong paper, which is an exact duplicate of the original tracing, and from which blue prints can be obtained, can be sent to and kept on file at the field office. [From a paper read before the society of The Municipal Engineers of the City of New York by Clarence F. Bell.]

Poor Painting—Occasionally we are compelled to look for the cause [of rapid deterioration of paint on steel] to the priming which was done at the mill. We are not certain beyond a doubt, so we decide to visit a mill and there make personal observations, which may very probably result as follows: In one part of this enormous plant we find the inspector busy in the pursuit of his duties checking, comparing specifications, testing, weighing, and attending to the many details connected with his work. In the meantime we notice in another remote part of the place a bunch of unskilled laborers mopping paint onto some steel that had been sent along for priming, using large 6-in. or 8-in. flat brushes, and covering over mill scale, rust, dirt and other imperfections, each and every one a destructive agent and an enemy to the life of steel. We observe all these stimulators of corrosion brushed over and covered up with paint, but not removed, and so the march of the corroding process is sure to go on. We next pay attention to the paint they are using, and learn that the package which was opened some time ago to be inspected, and was left standing uncovered all this time, had contained the standard paint as specified, but now, through neglect to properly cover, is no longer fit for the purpose used. On examining the contents of the package closely, we also notice that the paint is scarcely stirred up, and we see that the oily substance from the top of the mixture is first used, and as the work progresses and the material is consumed, the paint becomes heavier and intermixed with more or less pigment, until when the lower part of the package is reached nothing is left but a semidry pigment, which will no longer spread under the brush. Now, to assist in brushing, the men reach for the benzine can, and reduce the paint with it, destroying what little life the paint had first contained. In this way, a number of different surfaces and films are created, on the same structure, and from the same package of the so called protective coating.

We proceed further, and find at other parts of the mill, though this time under a covered shed, more laborers applying a shop coat to other sections and parts of the structural steel. Here we notice exhaust pipes of all kinds steadily discharging vapor and moisture, which finally settles and deposits on the steel. Under such conditions the steel cannot be perfectly dry, however much it may appear so, yet the painting is done just the same, these layers of moisture are inclosed between the surface and the steel, and the paint, which is supposed to close the pores and firmly adhere to the steel, is merely attached in some places and spots, and a weak foundation is created, which is absolutely unfit to receive and successfully hold subsequent coats of paint.

While we have gathered all this valuable information, the inspector has found an opportunity to inspect the painting on these various sections of the steel. He looks at the job, and as it looks uniform in color, he regards it as properly done, because it is outwardly covered over with paint. The material is consequently passed, loaded and shipped. —[From report of committee on "Painting Structural Steel" to American Railway Bridge and Building Association, October, 1912.]

The Settlement of a Disputed Boundary Line—Under this heading Homer C. White, County Surveyor, Mineral Ridge, Ohio, in a paper contributed to the "Journal" of the Ohio Engineering Society, gives an interesting case of the recovery of an old property line as follows:

The east boundary line of the defendant's lot was described as "a board fence now standing upon it." The fence in question had long since disappeared and its location was the bone of contention between the parties; and upon the determination of its location hung the suit. At the north end of the line in dispute and on the south line of the street was planted a stone monument, which was recognized and accepted by both parties as the north end of the boundary line. The claim of the plaintiff was that the line from this point should run parallel to the east line of her lot, giving her virtually the northeast one-quarter of lot No. 19 as called for in her deed. The defendant claimed that the fence had never run parallel to the other lot line, but that at the south end the fence had swung far enough to the east to admit of passage way from the southeast one-quarter of lot No. 19 to the northwest one-quarter of the same. A survey was made by the plaintiff which showed evidence that a stake had been found at the northwest corner of the southeast one-quarter of lot No. 19, and a straight line joining the said stake with the monument on the street was claimed by the plaintiff as the boundary line between the two properties. The recollections of a number of witnesses as to the location of the old fence were offered in evidence by the defendant.

The case was submitted to the court and a verdict rendered for the plaintiff. The case was carried by the defendant to the Circuit Court, and a surveyor was employed to relocate the old board fence. The surveyor began at the monument on the north end of the line and searched for marks of the old fence. The first hopeful sign, which was merely a depression in the sod, was at a point 66 ft. south of the monument. Carefully removing the top soil, the original post hole, still containing some of the rotten wood of the original fence-post was plainly observable. Keeping in range with the post hole just found and the monument, investigation was commenced for the discovery of the next post hole. These labors were soon rewarded with success, and having once determined the proper distance between posts, the rest of the work was simple. Having uncovered the old post holes the entire length of the line and having carefully centered them they were located with reference to a line passing through the monument, and a map was made from the notes thus taken. This map was made on a scale large enough and plain enough so that all three judges could see the map at the same time. Witnesses who had been used by defendant in the previous trial were brought upon the ground to observe the indications found of the old fence.

In due time the trial came on; witnesses were heard; the map submitted, and the verdict of the lower court reversed, in favor of the defendant.

The Effect of Geological Formations on Geodetic Measurements—In the course of the geodetic survey work of the United States Coast and Geodetic Survey in the Philippine Islands it has been found that there are frequently large discrepancies between the locations of the trigonometrical stations and of the astronomical stations. This has amounted, in some places, to 30″ to 40″ of arc, which may mean a

matter of half a mile or more on the surface of the earth. How to adjust this has been a matter of some difficulty. It was found over 50 years ago that in the great trigonometric survey of India there was a deflection of the plumb-line at various points, and it was shown that this was probably due to the great mass of the Himalayan Mountains. The great piles of volcanic rock which constitute the Zambales Mountains are adequate to explain the discrepancies at some of the stations on the west coast of Luzon. However, at Olongapo, it was found that the plumb-line instead of being deflected to the east, was deflected to the west, though the main mass of the Zambales Mountains lies to the east. An examination made by me several years ago of the Cinco Picos Range, which lies to the west of Olongapo, revealed the fact that these mountains are made up of one of the densest rocks known, the rock which is called peridotite. This rock has a density of over 3 whereas the main mass of the rock in Zambales to the east has a density only of about 2.5. Therefore, apparently, this discrepancy is explained by our knowledge of the geological features of the two regions. [Dr. Warren D. Smith in a paper read at a meeting of the Philippine Society of Engineers.]

An American Topographical Survey by English methods—The first point to be decided was the best unit of measurement to adopt. In British Columbia all land surveys are carried out with the Gunters chain, with the exception of those within town and city limits, where the 100-ft. chain is generally used. For the stadia levels a foot unit would have been preferable, but as the instructions called for the survey into lots of any land suitable for agriculture or grazing, which might be found while traversing the creeks, it was decided to use the link throughout, because it would have been very inconvenient to change the unit in the course of the work. The resulting computations were very laborious, however, and it would be much better in surveys of this nature to avoid including the complication of the demarcation of crown lands, and use the foot as the unit.

To avoid confusion with the demarcation of land lots, a steel stake was used instead of a wooden post; owing to the numerous bush fires also, it is believed this will be found more permanent. The stakes were driven with the head a little below the surface, and then covered with a cairn of rocks, whenever that was possible. These permanent marks were placed roughly about 1 mile apart, that is, close to every bench-mark, and were referred to a bearing tree.

Bench-marks were in every case on the stumps of as large trees as were available (generally felled for the purpose.) The practice was to drive a heavy 6-in. iron spike in the centre, and nail on to them galvanized iron plates, having the letters B.M. and the number painted on. The azimuth of the bench-mark spike was read to the nearest minute from the steel stake in every case, so as to provide means of picking up the work again. In all 66 bench-marks were established, each with a steel stake and cairn station and a bearing tree within a short distance, the triple marks being made to form a triangle when that was feasible. The bearing trees are also marked with galvanized iron plates, painted with the letters B.T. and the distance in links; the face towards the mark referred to. (From a paper by F. R. Johnson, M. Inst. C.E.) Proceedings of the Institution of Civil Engineers, 1912.

Wing Abutment Formulas

By George L. Jensen*

Laying out a wing abutment, when the layout is to be accurate rather than approximate, calls for some computations that are apt to be perplexing if the proper formulas are not ready to hand. These formulas and their derivation are given in the following.

Preliminary data in designing a wing abutment are: Width of bridge seat, width of back wall, batters, and footing offsets. The standards of the railroad building the bridge, or the other requirements of the case, fix all these quantities except the batters. These latter depend on the height of the abutment, the nature of the soil in the embankment, and the bearing value of the foundation soil. When from these quantities the proper batters have been determined, the remaining problem is to lay out the wing walls. The formulas about to be derived apply to this part of the work.

Assume the conditions to be as shown in Fig. 1. The governing angle of the wingwall, usually 15°, 30°, or 45° (although there is nothing to prevent its having any other value) is the angle between the base of the wing wall at the front and a line perpendicular to the center line of the bridge. Let this angle be θ. Then there remains to be determined the angle ϕ between the top of the wing wall and the front line of the base, and the angle Δ between the top of the wing wall and the back of the base.

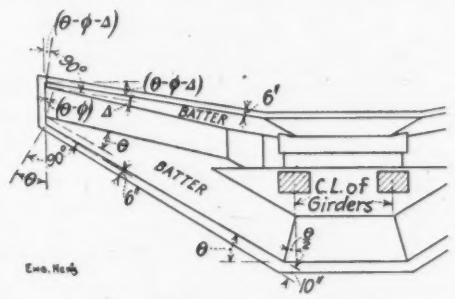


Fig. 1. Half Plan of Wing Abutment

To illustrate the derivation of the formulas by which these angles ϕ and Δ can be determined, a section of the wing wall formed by two parallel horizontal planes 1 ft. apart will be taken (Fig. 2). The wing-wall top being sloped to match the embankment at a slope of 1 on 1½ in a direction perpendicular to the center line of track, the top face will, in the height of 1 ft., approach the center line of track a distance of 18 in. But at the same time the face of the wing wall batters back a distance equal to B inches, and the back of the wing wall batters toward the face a distance equal to B' inches, where B and B' are the batters in inches per foot of height of the front and back faces, respectively. Then, for the face of the wing wall, AC in Fig. 2 represents the slope of the front edge of the top of the wing wall for the 1-ft. section, AD the slope of the front edge of any horizontal plane, and CG the slope of the front edge of a horizontal plane lying 1 ft. higher. The lines AD and CG are both at an angle θ to the face of the abutment, for they are on parallel sections parallel to the base.

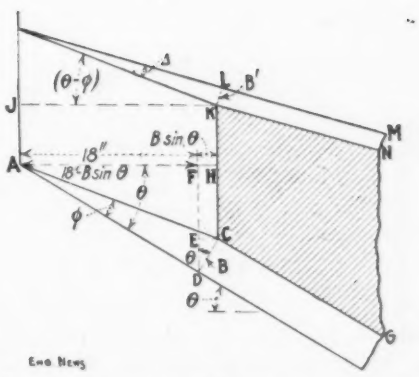


Fig. 2. Plan of Wingwall Section 1 ft. High

The problem is to find ϕ, the angle between AC and AD. Draw CD perpendicular to AD. Then CD equals the batter B. Draw FD parallel to KC which is parallel to the end of the wing wall. Then FD is at an angle θ to CD. Then

$$EC = B \sin \theta = FH$$

and

$$AF = 18 - B \sin \theta$$

But in triangle AFD,

$$AD = \frac{AF}{\cos \theta} = \frac{18 - B \sin \theta}{\cos \theta}$$

Hence

$$\tan \phi = \frac{CD}{AD} = B \div \frac{18 - B \sin \theta}{\cos \theta}$$

$$= \frac{B \cos \theta}{18 - B \sin \theta}$$

from which ϕ can be found.

For the back of the abutment, the angle Δ is derived as follows: Referring again to Fig. 2, IK represents the back edge of the top of the wing wall, parallel to the front edge; IM the slope of the back edge of any horizontal plane; and KN the slope of the back edge of a horizontal plane 1 ft. higher. The line IK is parallel to AC; therefore,

$$\text{angle } IKJ = HAC = \theta = \phi$$

Draw LK perpendicular to IM. Then $LK = B'$, the batter of the back face. Therefore

$$\sin \Delta = \frac{LK}{IK} = \frac{B'}{IK}$$

But

$$IK = \frac{18}{\cos (\theta - \phi)}$$

Therefore

$$\sin \Delta = B' \div \frac{18}{\cos (\theta - \phi)} = \frac{B' \cos (\theta - \phi)}{18}$$

from which Δ can be determined.

Knowing ϕ and Δ, any of the various angles shown in Fig. 1 can be determined and any of the computations necessary for laying out the abutment can be made.

*2137 Ainslie St., Chicago, Ill.

Letters to the Editor

Standard Sewage Treatment Tests

SIR—The writer has been asked to express his opinion on the paper of C. B. Hoover on "Standard Tests of the Efficiency of Sewage Treatment" published in ENGINEERING NEWS of Sept. 5, 1912.

Mr. Hoover has very properly emphasized the need of improved methods of testing. His paper is interesting and in the main his suggestions are good—all except that of forming a new society, which Heaven forbid! It is true there is in England a successful association of sewage-works managers, but in this country the need for such does not exist. Since Mr. Hoover's paper was published the Sanitary Engineering Section of the American Public Health Association has been organized, and a committee appointed to consider the general subject of the operation of sewage treatment works. This section ought to be a clearing house for the dissemination of information from the various sewage-works managers scattered throughout the country, and judging from the interest that was taken in the subject at Washington, this seems likely to be the case.

There are two principal things that the operator of a plant for the treatment of sewage desires to know. First, the extent to which the plant is performing the functions for which it was designed, and, second, the cost of the process. Other matters are important, but these are fundamental. In the case of a water-filtration plant, the object is to produce safe and satisfactory water. Direct tests of the effluent therefore furnish a measure of the efficiency of the process. Sewage-treatment works are different. Here the object is not to produce a pure effluent, but to so treat the sewage that it will not pollute the water into which it is discharged to an undesirable extent. If the effluent is discharged into a stream the real test of the practical value of the works must be determined, not by studying the effluent, but by comparing the quality of the water of the stream above and below the plant. I quite agree with Mr. Kimberly, who has discussed this paper (see ENG. NEWS, Oct. 10, 1912) that tests should be constantly and frequently made of the water into which the sewage effluent is discharged at various places below the works. Tests for this purpose need not be very elaborate but they should be made regularly and systematic records should be kept.

It goes without saying that tests of the sewage before and after treatment should also be made and it is these tests which Mr. Hoover has discussed in his paper. Standard methods are certainly desirable, but in view of the fact that the analysis of sewage is now undergoing a metamorphosis it may be questioned as to whether the time is yet right for the establishment of standard tests. Mr. Hoover is unquestionably right in stating that different methods of sewage treatment require the application of different tests.

It is very desirable that sewage-works managers in different places investigate the value of all available tests for their particular needs, and publish the results of comparative studies in order that the way may be paved for a system of standardized tests.

The writer wishes to emphasize, also, the importance of keeping accurate detailed data in regard to the cost of operation, and of so keeping the accounts that the cost of repairs can be distinguished from the cost of operation, and the labor costs from the costs of materials.

GEORGE C. WHIPPLE.
103 Park Ave., New York City,
Oct. 18, 1912.

Ozone Treatment of Water in Baltimore County, Md., and at Ann Arbor, Mich.

SIR—In an article in your publication under date of Oct. 10, 1912, you record a paper read before the Central States Water Works Association, by R. M. Leggett, of Ann Arbor, Mich., and in this there are certain statements relative to ozone purification of water in which Mr. Leggett makes the positive statement that purification at Baltimore [County] and other points has been an entire failure.

We would ask you to make the positive statement that such has not been the case [at the Baltimore County plant] as we have been able to maintain a bacterial efficiency of 90%, and further, that the only reason for withholding any data or statements relative to our work is that every indication has been that our bacterial reduction will be over 99%. We discontinued the operation of our plant on about Aug. 28 to make certain changes which we believe to be final, the apparatus for which is now in course of construction, and up to that time we had obtained a water, from the operation of this plant, having a bacterial count of about 50.

Mr. Leggett has never made an examination of this property, consequently is not in a position to make any statements whatever relative to its results or method of operation.

We, however, did send our chemist to Ann Arbor, Mich., and found that from the plant that he [Mr. Leggett ?] was then operating his bacterial counts were made on selective media and not in accordance with the standard method, and, therefore, for comparative results at that time were entirely worthless.

We have no desire to enter into any controversy as to the merits of Mr. Leggett's present scheme, but desire to say that the last word has not been said relative to the process of purification by the application of ozone.

A. E. WALDEN,
Supt. and Chf. Engr.,
Baltimore County Water & Electric Co.
Baltimore, Md., Oct. 19, 1912.

Notes and Queries

Errata—In the article on "Vertical Curves, Spirals and Connecting Curves for Meter-Gage Railways," in our issue of Sept. 5, there are a few errors in the list of formulas (p. 437.) The corrected formulas are as follows:

$$L = (d + T) - p \csc \Delta$$

$$p = x - (R \text{ vers } S)$$

$$h = \frac{p}{\cos \frac{1}{2} \Delta}$$

$$M = T + (p \csc \Delta)$$

In the ninth line of the second column, p. 437, the formula should be $(n^1 - n) \times c$. In the eleventh line the s should be a capital, and in the twelfth line the correct reading is as follows "for $n^1 = 15$, $S = 20°$." Finally, the sixteenth line should read "From the 6° curve Δ deduct."

In the tables there are a few typographical errors, as follows:

Table I.—Column N^1; 10th and 14th lines should be, 0.005.

Column N^9; 12th line should be 0.413, and 43rd line should be 0.664.

Column N^{10}; the 29th and 30th lines should be 0.680 and 0.690.

Column N^{11}; the 15th line should be 0.653.

Column N^{15}; the 32d line should be 1.598, the 40th line 1.778, and the 44th line 1.868.

In the line of "Constant diff.", 0.0014 should be 0.0016.

Table II. In the second line for 4°30′ the signs are transposed (which is obvious), and in this line under column Y, 59.17 should be 39.17. In the second line for 13°, 46.0 should be 36.0.

Table IV. The 10th line of column 13 should be 3°38′ (instead of 2°38′). The 8th line of column 16 should be 7°53′ (instead of 7°43′.) The 6th line of column 17 should be 9°31′ (instead of 8°25′.) The 15th line of column 18 should be 5°18′ (instead of 5°78′.) The top line of column 19 should be 10°48′.

In Fig. 2, the lettering $\Delta - 25$ should be $\Delta - 28$.

Issued Weekly by the
Hill Publishing Company
JOHN A. HILL, Pres. ROB'T MCKEAN, Sec'y.
505 Pearl St., New York.

Monadnock Bldg., Chicago.
6 Bouverie Street, London, E. C.
Unter den Linden 31—Berlin, N. W. 7.

CHARLES WHITING BAKER, Editor.

Subscriptions payable in advance, $5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $7.00 in Canada.

To foreign countries, including postage, $9.00 or its equivalent, 36 shillings: 36 marks: or 45 francs.

Notice to discontinue should be written to the New York Office in every instance.

Advertising copy should reach New York Office by Thursday of week before date of issue.

Entered at New York Postoffice as mail matter of the second class.

CIRCULATION STATEMENT

During 1911 we printed a total of 931,958 copies.

Of this issue, 18,800.

None sent free regularly, no returns from news companies, no back numbers.

Contents

	Page
*Extracts from the Annual Report of the Isthmian Canal Commission	939
*Protection for Hollow Reinforced-concrete Dams; G. L. Bilderbeck..	948
*An Apparatus for Sterilizing Water by Heat	949
Failure of an Earth and Timber Dam at Hamlin Lake, Mich.	950
The Largest Side-wheel Steamer in the World	950
Handling the Smoke Problem in Chicago; Osborn Monnett	952
*The Present Status of Culebra Cut, Panama Canal	953
A New Process of Timber Preservation	954
*Producing Sound Ingots; Robert Hadfield	955
Prerolled Pipeless Ingots; Benjamin Talbot	957
FIELD AND OFFICE:	
*A Gantry Support for Bridge Staging	960
*Two Safety Devices for Tunnel Work	960
*A Hand Operated Percussion Rock Drill	961
*A Field Kitchen Wagon	961
Economy of Careful Planning in Construction; R. R. Raymond	961
Railway Works in Brazil	962
*A Flat-filing Form of Railway Location and Similar Maps; R. C. Hardman	962
Unskilled Labor	963
*Storage-battery Locomotives in Tunnel Excavation Work	964
Plotted Curves and Curve-sheets	965
A Uniform Map of the Earth's Surface in 1500 Sections	966
*A Test for the Chiseling Resistance of Stone; Wm. A. Parks	966
A Philippine Civil Service Examination	967
*Wing Abutment Formulas; George L. Jensen	969
*A Self-contained Oil-firing Device	975
*Gasoline Car-ferry for an Electric Railway	976
The Use of Oil as Fuel; A. O. Krieger	978
*Two Civil Engineer Presidents of the Pennsylvania R.R.	980
Some Objectionable Features of Government Contracts	981
LETTERS TO THE EDITOR	970
EDITORIAL	971
Railway Competition in New England—Building 1000-ft. Piers at New York City—Better Ingots—A New Phase of State Supervision of Dams—Concerning Expert Testimony by Engineers.	
ENGINEERING NEWS OF THE WEEK	982
PERSONALS	983
ENGINEERING SOCIETIES	984

*Illustrated.

Engineering News

Railway Competition in New England

A veritable tempest in a teapot has agitated New England during the past week or more, and indeed the tempest might be limited to even smaller dimensions since the storm center is located in Rhode Island. What the meteorologists might call a secondary storm center, however, hovers around Boston. The tempest referred to relates to the stopping of construction work on the extension of the Grand Trunk's Southern New England R.R. from Palmer, Mass., to Providence, R. I., a distance of 58 miles. Suspension of work on this branch has at the same time been accompanied with announcements, more or less definite, that the project for an independent Grand Trunk line into Boston from a point on the Central Vermont system in southern New Hampshire has also been definitely abandoned.

The declaration has been made that the Grand Trunk has stopped work on these extensions to its system by virtue of a secret alliance with the New York, New Haven & Hartford, under which the competitive war in which these two systems have been engaged to a greater or less extent for the last two years is to come to an end.

The above is a brief statement of the circumstances which have led the Governors of two states to embark on an aggressive campaign against this new attempt to throttle competition and they have even sought to enlist the aid of President Taft and the Interstate Commerce Commission in the task of finding a sword to hold over the heads of President Mellen of the New Haven, and President Chamberlain of the Grand Trunk.

There is this much excuse for the present tempest in New England, that the Grand Trunk's campaign to secure public interest in its new line to Providence and its extension to Boston was carried on with the usual promises as to what new competition was to do for the benefit of the commercial public. The expectations, based on these promises, were doomed to disappointment in any event, for neither the ruling grades nor the physical condition of the Grand Trunk's Central Vermont line are such as would enable it to play any very important part in the competition for through traffic to Boston and the West.

The building of the branch to Providence, as well as the projected extension to Boston, meant, we believe, nothing more than a scheme on the part of Grand Trunk managers to obtain enough traffic for its unfortunate Central Vermont system so that it might pay a little something on its invested capital. The Providence extension is probably justified by the local traffic it may secure in the regions that it penetrates as well as in the contribution it may bring of traffic to the main line, but that an independent Boston extension with the enormous necessary expense for terminals would be only a losing investment for the Grand Trunk will probably be the opinion of conservative financiers.

Meanwhile, the case is of interest as an example of the importance of any process of law to compel competition. "You may lead a horse to water, but you cannot make it drink." The law may, indeed, require that the doors for competition shall be left open; but if the Grand Trunk managers finally decide not to pursue its schemes for competition in the New England transportation business there seems to be no way by which they can be compelled to do so. If the present administration concludes that the Providence extension and the Boston extension were on the whole unwise and that it is better to abandon them than to expend further money upon them, there is no way in which Rhode Island or Massachusetts can compel the company to make the expenditure.

The moral of the whole affair is that the public must look for its protection in securing reasonable rates of fare and freight, and good service to state and federal regulation. Competition in the railway business is no longer a reliance.

Building 1000-ft Piers at New York City

We heartily commend the breadth of view of Secretary of War Stimson in denying the petitions for the right to extend the piers on the Hoboken and Manhattan water fronts of the North River farther out into the stream at its narrowest parts. Certain commercial interests of New York City have been vociferous in their demand that the privilege of pier extension be granted, lest the three or four huge transatlantic liners now under construction, which far exceed the dimensions of any vessels hitherto built, should forsake New York for other ports. Secretary Stimson, however, and his engineer advisers are by this action protecting the commercial future of New York. Because that city has along its westerly water front one of the most spacious inland waterways of the world is all the more reason why that waterway should be preserved against unwise at-

tempts to obstruct it, thereby increasing the velocity of tidal flow and the risk of collisions to ships maneuvering in and out of the slips.

Secretary Stimson's decision, which is without doubt made in conformity with the advice of the ablest officers in the Corps of Engineers, is in fact a case where the far vision and breadth of view of the engineer is able to prevent the short-sighted commercial man from perpetuating a serious public injury for the sake of grasping at an immediate present gain.

We are glad to say, however, that Secretary Stimson's decision seems to be accepted as final. It is perhaps realized by the more influential men in commercial circles that the Secretary is, in fact, protecting the city against itself, and that his action will prove in the long run to be for the city's best interest.

As the city is precluded from extending piers out into the North River beyond the present pier-head line, it is now proposed to take the other alternative and extend the slips farther inland, of course at enormous expense because of the valuable real estate which must be sacrificed. According to newspaper statements, Mayor Gaynor has seriously proposed to the Board of Estimate that the city should build eight piers at least 1000 ft. long on the upper part of the North River waterfront in the vicinity of 50th St. No estimate of the cost of such a wholesale scheme of dock and pier construction has been made; but when it is made it is safe to say that the total sum will cut a large figure even in New York's enormous budget.

It is apparently taken for granted that inasmuch as three of the great steamship companies have built or are building steamers too long for the present North River piers, New York City must, therefore, put its hand in its pocket and provide longer piers, and that it must do this in the particular place which best suits the steamship companies' convenience regardless of the fact that the city already owns piers in South Brooklyn some 1500 ft. or more in length at which these long vessels could readily be accommodated.

It occurs to us to suggest that if the city really must assume the burden of building these exceptionally long piers for these exceptional steamships, it would be the part of wisdom to build *one* pier of this length instead of eight. A single pier of this length will furnish accommodations sufficient probably for several years to come for all the steamships too long to be berthed at the ordinary piers.

It ought to be more generally understood that these huge vessels of the "Olympic" and "Imperator" class are as yet an experiment and one which can only hope to succeed at all under the conditions which prevail in the ocean passenger traffic between New York City and Europe. On every other steamship route in the world, vessels of 12,000 to 16,000 tons are considered very large—and it is yet to be demonstrated that even on the transatlantic voyage, the 25,000- and 30,000-ton boats will not prove to be better paying vessels than the two or three leviathans which have been constructed within the last three years and of which the "Titanic" was an unfortunate example.

It may perhaps be objected that to have only a single pier 1000 ft. in length to serve the three or four, or possibly five, exceptionally huge boats which may be completed within the next three years would be insufficient. In answer to this it may be said that such accommodation as this would be considered liberal in other great ports of the world. Take for example the great English port of Liverpool; there is at that port a single floating landing stage at which all passenger vessels entering or leaving the port have to take on and disembark their passengers. It often happens that one vessel must wait a considerable time in the stream before it can find a vacant place at the landing stage. Also it can remain at the landing stage only long enough to take on and leave passengers and their luggage, and all freight must be handled to and from the steamer elsewhere.

Better Ingots

As the lumber cut from a tree contains all the defects that existed in the log, so rolled steel carries the defects of the ingot. The steel-rolling process in commercial use has the peculiarity that every rolled bar represents the whole ingot (or at least the whole cross-section of the ingot), merely reduced in scale transversely and stretched out longitudinally; and so the irregular distribution of hard and soft areas in the ingot section is pictured in the cross-section of the finished bar, the porous spots or blowhole zones of the ingot appear as flaws and unsound areas in the finished steel, and pipes or cavities are perpetuated as seams.

This being true, doubtless the steelmakers give very careful study to the production of sound, solid and homogeneous ingots—so it will be thought. But as a matter of fact, very little, if anything, has been accomplished in the direction of bringing ingot quality up to a high grade.

The great importance of sound ingots has always been admitted. Indeed, the ingot question has been recognized as one of the burning questions of steel manufacture, so to say. In spite of this, while progress has been made in improving the chemistry of steel, in perfecting the methods and machinery of rolling, and in securing greater speed and economy of production, no progress whatever can be recorded in the ingot matter. The conditions recognized as harmful have been tolerated indulgently as ineradicable evils.

The two papers on producing sound pipeless ingots which we publish in this issue have the great merit of arousing new interest in the solution of the problem. Probably they will also start up some real activity in the way of study and experiment concerning possible methods of eliminating unsoundness, segregation and piping. Certain methods have been available before now, but (at least in this country) a great disinclination to take them up has been manifested. The reasons therefor are a little obscure, but the fact is generally known. The disinclination toward any changes in ingot-casting methods is evident, for example, in the apathy of steelmakers toward the numerous suggestions and proposals to improve steel quality by slower teeming (pouring) of the ingots.

But the methods now proposed for producing ingots free from piping come at a peculiarly fortunate time. Accumulating experience with rail failures and their scientific study in many fruitful directions have together forced home the conviction that all rail troubles have their origin in the ingot. That is to say, heterogeneous segregated metal, and seams resulting from blowholes or remnants of pipe, are the principal and perhaps the only causes of the disastrous breakages of rails which for the past half dozen years have been so prominently a matter of interest in the railway field. Perhaps this fact is primarily responsible for the interest which was apparent at the reading of Mr. Benjamin Talbot's short paper before a select company of railway and steel men recently in New York City.

It was stated that Talbot's process would be tried at one of the steel works. There are good reasons for believing also that Mr. Hadfield's method will be given a trial. If these trials are serious and carried on with energy and intelligence, as seems probable, nothing can be more certain than that American steelmakers will be led into close study of the segregation and piping problem, and that they have good chances of developing still further methods of dealing successfully with the ingot problem.

Piping and other ingot troubles are so often restricted to discussion of steel rails that the impression is apt to gain ground that no other branch of the steel industry is concerned, and that in the rolling of plates and structural shapes, for example, conditions are thoroughly satisfactory. The fact is that plates and structural shapes suffer perhaps fully as much as rails from ingot defects. But they are in less trying service. The critical severity of service to which rails are exposed is the chief reason why interior faults are in their case more frequently brought to light. The structural engineer particularly should remember, however, that the very same conditions that

ore revealed in a disastrous rail break may prevail in a certain small proportion of the I-beams and plates which he uses in his structures. Brittleness in beams and plates is not altogether unknown. Thus, it is quite probable that an improvement in the methods of ingot casting and treatment adopted primarily for the benefit of rails will also have a very desirable effect in raising the grade of other rolled steel products.

We have heretofore referred to the new methods proposed by Hadfield and Talbot, respectively, as though they could, at least when at their best, produce a perfect and uniform steel. That this is not the case, however, is seen most clearly in Mr. Talbot's explanation of the peculiar distribution of the segregation zone, in the ingots made by his prerolling process. It is still a matter of future determination whether any method can be so developed as to produce a wholly uniform steel, or whether we can get along just as well with a steel which is not entirely uniform, but uniform within certain limits of variation.

A New Phase of State Supervision of Dams

When a dam goes out and allows an escaping torrent to wash its way through houses and farms of downstream residents, damages for loss of property and life properly lie against the owner of the dam. We say "properly" because in actual practice such damages are rarely obtained. In one recent notorious case, for instance, where the dam collapse was due to the obvious negligence of the owners, damages for the many lives and valuable property lost were avoided by the rankest sort of legal evasion—a transfer of ownership in name and legal status but not in fact. We believe, too, that these owners still retain the regard and respect of the community where they live, which, however, is not the one in which the dam was located.

This very general legal evasion of just responsibilities is doubtless the primary cause of the popular sentiment for governmental control of dams, which, in some states, has already crystalized into legislation. If men are not sufficiently concerned about the lives and property of their downstream neighbors to provide of their own accord safe structures, which will not endanger those neighbors, the government by some means other than the ordinary process of law must be empowered to enforce such safety. This seems fairly obvious. But there are many places in this country where the necessity for government supervision of dams rests on less obvious conditions where, particularly, there is no definite ownership of the questionable dam and where the danger to citizens is indirect, though none the less real. No better example of such instance could be selected than the Hamlin Lake Dam failure, noted on another page of this issue.

This structure was unimportant in scope and character; its design, construction and end were common enough in dams of its class, and the property damage directly resulting from the flood waters rushing through the open channel below when the dam broke was practically nil. Nevertheless, this dam serves admirably to point the moral. It was originally built and maintained by the lumber company which operated on the bank of the sizable lake made by the backed-up waters of a little river; and doubtless in the early days this use was the only one to which the lake and dam were put. As time went on, however, the pleasant surroundings of the little lake drew to it a number of summer cottagers who probably soon forgot that the lake was artificial. The lumber company gradually exhausted the timber which could be floated on the lake, and while it seems to have felt some measure of responsibility for the safety of the dam (since at the time of its failure workmen were engaged in reducing the pressure against it) it was not sufficiently interested to provide a reasonably safe structure. At the same time the local property owners were indifferent to the structure that created the lake upon which depended the very existence of the summer colony.

Then the dam went out and the waters of the lake drained slowly away through a sandy and barren channel to Lake Michigan. The wake of death and property destruction often following a burst dam was conspicuous by its absence; but on the other hand, the upstream property was seriously damaged, not by the presence of too much water, but by the absence of the usual amount of water. Landing piers in deep water were left high above muddy morasses and summer cottages were rods away from the water which once they bordered. No property was injured below the dam, but property values were just as surely destroyed as though a flood wave had washed its way through all the buildings and grounds.

The responsibilities involved in the ownership of a dam creating a lake so long established as to be regarded as permanent are, at best, doubtful. Even though the company owning the Hamlin dam realizes its moral responsibility, it is hardly possible that it could be legally compelled to restore the dam or to compensate the upstream riparian owners. These owners, then, are forced to suffer serious loss because of their complacent ignorance of the dam's weakness.

The Hamlin dam is not an isolated case, but a typical one. An instance of much more serious consequence is that greatest disaster in all history due to a dam failure, the Johnstown flood. Doubtless not one in a hundred of the unfortunate inhabitants of Johnstown had ever heard of the little lake maintained by a country and fishing club in the forests on the headwaters of the South Fork. Even if the club could have been held to financial responsibilities for the damage done when its dam failed the property loss exceeded ten thousand times over the club's financial ability to pay for losses, and no money compensation could restore the thousands of lives lost.

Dozens of similar instances could be pointed out where an old mill pond or reservoir, long since abandoned by its original owners, is considered as permanent a fixture of the landscape as the everlasting hills and receives no greater amount of supervision. If such a dam goes out, even though its leaky condition has long been local knowledge, its failure is classed along with earthquakes, landslides and cloudbursts as an act of God and, therefore, not preventable or to be anticipated. Specific legal and moral responsibility are lacking, and what is everybody's business becomes nobody's business. There remains only one solution of the difficulty, the education of the people to their own responsibility, which must result in the interposition of government authority.

Communities have short memories for cataclysms. They will rebuild in their original form cities ruined by fire and earthquake and return again and again to volcano-swept hillsides. In the same spirit, men are oblivious to the danger of silent natural forces. They will live in peace and comfort in the shadow of a great dam, on the assumption that someone is looking after their safety. Where such a one is false to his trust we have the type of failure which state supervision is primarily intended to prevent. But where the dam is apparently small and inconsequental and its ownership doubtful the need for government supervision of its construction and maintenance is, if anything, greater, because no one else can be held to responsibility for the dam's safety.

In the six days from Oct. 26 to Oct. 31 five fair-sized dams in this country failed, in such widely separated states as New York, Washington, Nebraska, Ohio and Colorado. In one month last spring five dams went out in one county in the State of New York. These are exceptional cases but hardly a day goes by that does not bring to this office newspaper clippings telling of the failure of a dam. We are convinced that taken as a whole there is more disregard of engineering principles in the design and construction of dams than in any other structure, and that this disregard results in more damage to property and loss of life than can be laid to the combined failures of bridges, buildings, piers and all other static structures. Something must be done to raise the standard of

design in these structures and we can imagine nothing more effective than a state board which can refuse to authorize the construction or maintenance of a dam until its owner presents evidence of the exercise of qualified engineering talent in its supervision, and which in the absence of an owner can take entire charge of the protection of the adjoining territory.

Concerning Expert Testimony by Engineers

At the last meeting of the American Institute of Consulting Engineers, held in New York City, Oct. 25, the evening was devoted to a discussion of the subject of expert testimony and needed reforms therein. In the course of the discussion it was stated that a search through the columns of ENGINEERING NEWS extending back for seven years had revealed no editorial upon the subject in that time. On that basis we may justly take space at this time to present a summary of the very interesting discussion which took place at the recent Institute meeting.

In the first place, whatever differences of opinion engineers may hold as to the reforms which should be made in methods of presenting expert testimony, it is agreed by all familiar with the matter that the present methods of presenting expert testimony in law cases leaves very much to be desired.

Engineers of high standing and judicial temperament who have had experience in testifying as experts almost invariably are aroused to make protest against the common assumption that the expert witness on a side is as much a partisan as the lawyer employed upon that side, and that it is his duty to make a return for his fee by twisting the evidence into as favorable a light as possible for his side.

To present testimony in such a way as to make black appear white and to confuse instead of making clear the issues presented, goes against the grain of any honest and high-minded engineer. Such engineers, in fact, avoid giving testimony in cases where they are expected to deal with scientific facts after this manner. The result is that the business of testifying as an expert in courts of law tends to gravitate into the hands of less conscientious men who have no scruples against testifying as the lawyers wish them to testify. Such a situation is highly unfortunate, both for the ends of justice and for the engineering profession.

It is of interest to note that an eminent engineer who was present and took part in the Institute discussion is entitled to the credit of having first brought the subject definitely before the engineering profession. We refer to Clemens Herschel who, 26 years ago (in 1886), published a pamphlet in which he reviewed the general subject of expert testimony, the abuses then (and now) prevalent and the customs prevailing with regard to expert testimony in England and Germany, as well as in the United States.

In this pamphlet Mr. Herschel took strong ground in favor of the appointment of experts by the Court, a practice which has been followed in Germany ever since the formation of the German Empire. Mr. Herschel's position in this matter attracted much attention at the time and received favorable comment from many quarters. Like many another scheme for needed reform, however, no practical results came of the publication. There was no organization to take up the proposed reform and carry it forward into practical execution.

In the discussion at the recent Institute meeting, Mr. Rudolph Hering, who opened the discussion, took strong ground in support of Mr. Herschel's position of 26 years ago. We quote from Mr. Hering's paper the following summary of his opinion as to the best methods of employing expert witnesses to attain the ends of justice.

> The best way to satisfy the above requirements, therefore, seems to be that the Court appoint experts for the purpose of having them present to it all unquestionable facts and conclusions regarding the case. This procedure should satisfy the first condition, namely, as to facts.
>
> As these experts will then have become acquainted with the facts in the case, they should, in addition to performing the first duty, be able to testify also as to their individual opinions. But, regarding such opinions, they should be subjected to an examination by the attorneys of both sides, either as though they were their own experts, or for the purpose of discovering by cross examination whether they have been biased, loose or speculative in forming their opinions.
>
> In this examintaion the attorneys may be prompted themselves by ex parte experts also possessing special knowledge, who would know how to bring out the strong or weak points in the opinions of the Court experts.
>
> It may then be found that the Court's experts have unsafe opinions, as well as the ex parte experts, and that the Court should not be bound by them, but should be able to change its experts if it desires, which liberty is granted in the Courts of Continental Europe, where also the challenging of an expert by either side is permitted.

It will be noted in the above quotation from Mr. Hering's summary, that the appointment of experts by the Court does not necessarily preclude the employment of experts by either side. It was brought out, in fact, in the discussion at the Institute meeting, that there are cases tried in which it is quite necessary that either side should have their own expert who should spend much time in careful study and investigation of the problems at issue before they are brought into court.

It is, in fact, more often than not the case that before an engineer will testify in court upon a technical matter, even though it be one with which he is thoroughly familiar, he will wish to spend some time in preparation, studying up recent authority and perhaps making tests and experiments. Such work is often carried months before a case comes to trial, and must necessarily be done by experts employed by either side.

The Court itself could hardly undertake to appoint experts in a case precedent to its being brought to trial, for there is always a chance that the case may be settled out of court before the trial takes place.

Another very practical obstacle to a court-appointed expert engaging in extended studies and investigation is that the fees of the court expert are fixed by law and when so fixed would be naturally very much below the scale often paid to expert witnesses employed by either side.

It is in fact one objection to the appointment of experts by the Court that the fees fixed by law for such experts are generally insufficient to recompense high-grade men for the necessary expenditure of time. Suppose, for example, that a client has a case involving a very large sum. In order that his case may be properly presented he is willing to expend a liberal amount to have a high-class expert give time to a thorough study of the technical points involved. It is often necessary that the case be presented to the court in this way in order that it may be fairly understood. It would be a hardship tending to defeat the ends of justice to forbid a man with such a cause having such investigations made, and from bringing the expert witness who makes them into court to present his testimony.

As Mr. Herschel clearly pointed out in his pamphlet above referred to, however, the appointment of experts by the Court does not necessarily preclude the employment of other experts by the respective parties to the case, and the same thing is brought out in the quotation from Mr. Hering's paper above.

An important and valuable suggestion made by Gustav Lindenthal in the course of the discussion was that in cases whose decision turns largely upon technical questions requiring the employment of experts for their elucidation, the ends of justice would be best served if both parties would agree to adopt arbitration instead of the ordinary court procedure to determine their case.

The Chamber of Commerce of New York City has taken this matter up and has provided a standing committee upon the subject of arbitration. It has had legislation enacted which enables parties to have their cases presented and decided in a simple and economical manner without resort to the courts.

This procedure is especially adapted to cases involving technicalities in which

the parties involved can agree upon the membership of a board of experts, say three in number, and allow these experts to hear both sides of the case and determine for themselves in a judicial manner the technical points involved. The ends of justice will be better served by such a board than they are likely to be in even the best conducted court of law.

There are many cases at issue under present-day commercial conditions where values to the extent of many thousands of dollars may depend upon some abstruse matter relating to the chemical or physical composition of a substance, the indications of a polariscope, or a draft tester, or a Ringelman smoke scale. Which is more likely to arrive at a decision in such cases? A man versed in the art in which the suit is brought and in all its technicalities, who is agreed upon as an impartial judge by both sides of the case and who realizes his duty as a member of a learned profession to search out the truth and render a decision in accordance therewith; or, on the other hand, a lawyer whose whole experience has been as a partisan, representing the one side or the other of a law suit, and accustomed to use all possible means within legal limits to win his case. Such a man, with political influence sufficient to secure nomination and election by one of the political parties, represents, unfortunately, the typical judge now presiding in the courts of many states.

A considerable part of the time devoted to the Institute's discussion was taken up with the subject of expert testimony in patent cases. There is perhaps no branch of expert testimony which more needs radical reform than the present methods of conducting patent litigation. It is true that those who took part in the Institute discussion, Frank Waterman and James M. Gifford, both spoke in defense of the present system. They freely admitted, however, that the enormous volume of the expert testimony taken in patent cases under the present system tends to break down the whole system. As Mr. Gifford said, the judges who try these cases are overburdened with work. It is well nigh a physical impossibility for them to even read, much less give careful and intelligent study to the entire record of important patent cases. The manner in which expert testimony is employed in patent cases at present tends to make the whole patent system break down of its own weight.

While the speakers above quoted opposed the proposition that the judges should be empowered to appoint experts to aid them in reaching decisions, we believe engineers generally will agree that either the judges who sit in patent cases should have some technical education or else they should be aided by the advice of impartial experts. In fact both these conditions ought to obtain.

With the rapid progress of science and industry, patent litigation over new inventions grows inevitably more technical and abstruse all the time and beyond the comprehension of the layman. Take a case involving the latest developments of metallography or of bacteriology. The very nomenclature involved is foreign language to a layman. Unless the case between the litigants can be judged with clear understanding of the points at issue, the parties might as well toss a coin to see which shall win as go to the great expense of a trial.

It is indeed worth consideration whether the questions at issue in patent cases might not be submitted to arbitration instead of dragged for years through the courts, as they are by the present system. Possibly the new rules of procedure for the federal courts, just announced by the United States Supreme Court, may afford some improvement in the conduct of patent litigation. That improvement is greatly needed even the defenders of the present system admit.

A Self-Contained Oil-Firing Device*

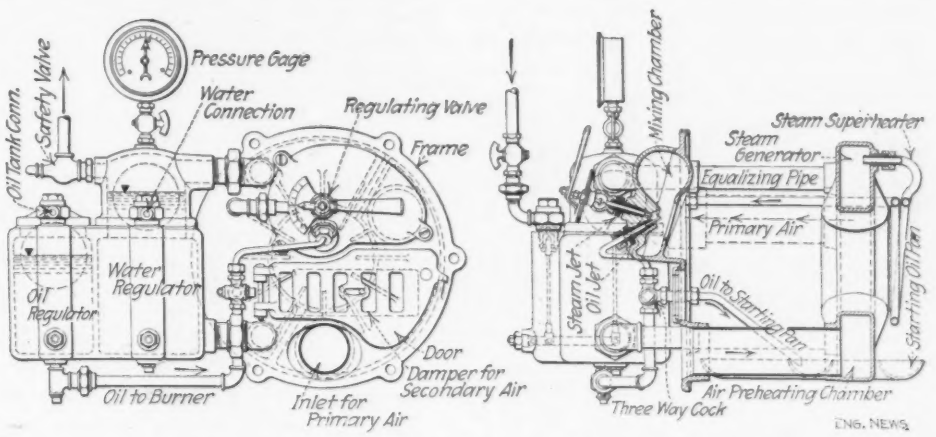
An atomizing oil burner for small boiler installations has been designed by Adolf Tacchella, of St. Louis, Mo. It is intended for the combustion of low-grade oils and the principal features of interest relate to the self-contained nature of the device. No exterior source of pressure is required, as the burner generates its own steam for feeding and atomizing fuel.

As shown in the accompanying figure, the main parts comprise the oil and water reservoirs or supply regulators, the steam generator, the burner valve, mixing chamber, air-heating space and starting-oil pan.

The oil-regulating reservoir holds its level through a float valve on a gravity or pressure supply. The burner is supplied with oil by the suction of the steam nozzle at the burner valve. The water reservoir is piped to a city-pressure or other suitable system and level is held by a float valve.

The steam generator occupies half of the ring through which the flame is shot, the other half forming the air preheater. The generator and water reservoir are pipe connected; steam is carried from the generator through a single-turn superheating coil before going to the burner valve. Here it is hand-controlled by a needle valve. The working pressure varies from 4 to 8 lb.; at the latter value a safety valve comes into action.

*From information furnished by Tacchella and Krieger, St. Louis, Mo.



ELEVATIONS OF THE TACCHELLA ATOMIZING OIL BURNER

The steam and atomized oil are mixed with preheated air, but a damper directly admits more air as needed.

The general operation is as follows: By opening a three-way cock in the burner or supply pipe a small amount of fuel is turned on to the asbestos packing of the starting pan for ignition. In a few minutes after lighting enough steam is generated to start atomizing oil. The flame is then regulated by the steam needle valve; the longer the flame the more steam there is generated and the more fuel there is fed. The flame can be regulated for between 8- and 3-in. lengths. There are two sizes of burner now being marketed. One has a consumption capacity of from ½ to 2 gal. of oil per hr., the other from ⅛ to 1 gal.

Recovery of Anthracite from Old Dumps—The production of anthracite in Pennsylvania includes an appreciable quantity of usable fuel recovered from the old culm banks by washeries, and the unsightly monuments to the wasteful methods of early times are disappearing from the landscape in the anthracite region. The quantity of coal recovered in the 22 years since the first washery was constructed in 1890 has amounted to about 50,000,000 long tons. In 1911 the washery product amounted to 4,136,044 long tons. In addition to the coal recovered from the culm banks, 94,647 long tons in 1911, and 91,833 tons in 1910, were recovered from the bottom of Susquehanna River by dredges.

Gasoline Car-Ferry for an Electric Railway

A car-ferry or car-transfer boat has been put in operation recently on the Ohio River which has two special points of interest. In the first place it is believed to be the first car-ferry for electric interurban railway service, and in the second place the boat is operated by gasoline engines.

The Evansville Railways Co. operates an electric interurban railway between Evansville, Ind., and Henderson, Ky., a distance of about 10½ miles, and this line strikes the Ohio River about midway between the two cities. To effect the connection a car-transfer boat has been put in service, being used as an ordinary passenger ferry until the car inclines and cradles were completed. The two cities have populations of 75,000 and 15,000, respectively, and it is intended to operate an hourly service of cars. The Illinois Central R.R. formerly operated a train-ferry at this point, but abandoned this when it secured the right to use the Louisville & Nashville R.R. bridge at Henderson. It still uses the incline tracks on each side of the river for freight service, in transferring freight from boats to cars, and the electric railway has secured a lease for the joint use of these Illinois Central R.R. tracks. The connection with the boat is effected by a cradle which is mounted on wheels and is run up or down the incline according to the varying level of the river.

FIG. 1. GASOLINE CAR-TRANSFER BOAT ON THE OHIO RIVER; FOR THE INTERURBAN CARS OF THE EVANSVILLE RAILWAYS CO., EVANSVILLE, IND. (Evansville, Henderson & Owensboro Division.)

The boat and its machinery were designed by Morris M. Whitaker, Naval Architect, of Nyack, N. Y. The boat was built by the Dubuque Boat & Boiler Works, of Dubuque, Ia.; and the engines were supplied by the Buffalo Gasoline Motor Co., of Buffalo, N. Y.

THE CAR-TRANSFER BOAT

The car-transfer or ferry-boat is 120 ft. 8 in. long over all, 25 ft. beam, 34 ft. wide over the guards (at the paddle-boxes) and 4½ ft. deep. It is designed to carry two 50-ft. 45-ton interurban cars on a draft of 3 ft., the displacement being about 150 tons under this load or 110 tons with one car. As a rule, the load will consist of only one car. The time of crossing is from 6 to 15 min.; it depends upon the stage of the river, the distance between landings varying from half a mile to a mile. The boat is propelled by side wheels, each wheel being driven by a gasoline engine. The hull is of steel, with wood superstructure. The pilot house is carried by a central steel tower, and four pipe frames support the trolley wire. Fig. 1 is a view of this gasoline car-ferry, which is named the "Henderson."

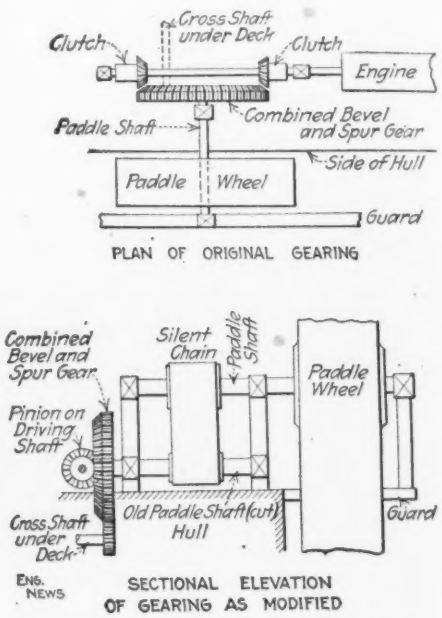


FIG. 3. ORIGINAL AND MODIFIED ARRANGEMENTS OF GEARING BETWEEN GASOLINE ENGINE AND PADDLE WHEEL

The hull is practically a rectangular steel box, with flat bottom and rounded ends, and its construction is shown in Fig. 2. Its principal structural feature is the use of two longitudinal bowstring trusses, having the bottom chords integral with the floor of the hull, while the

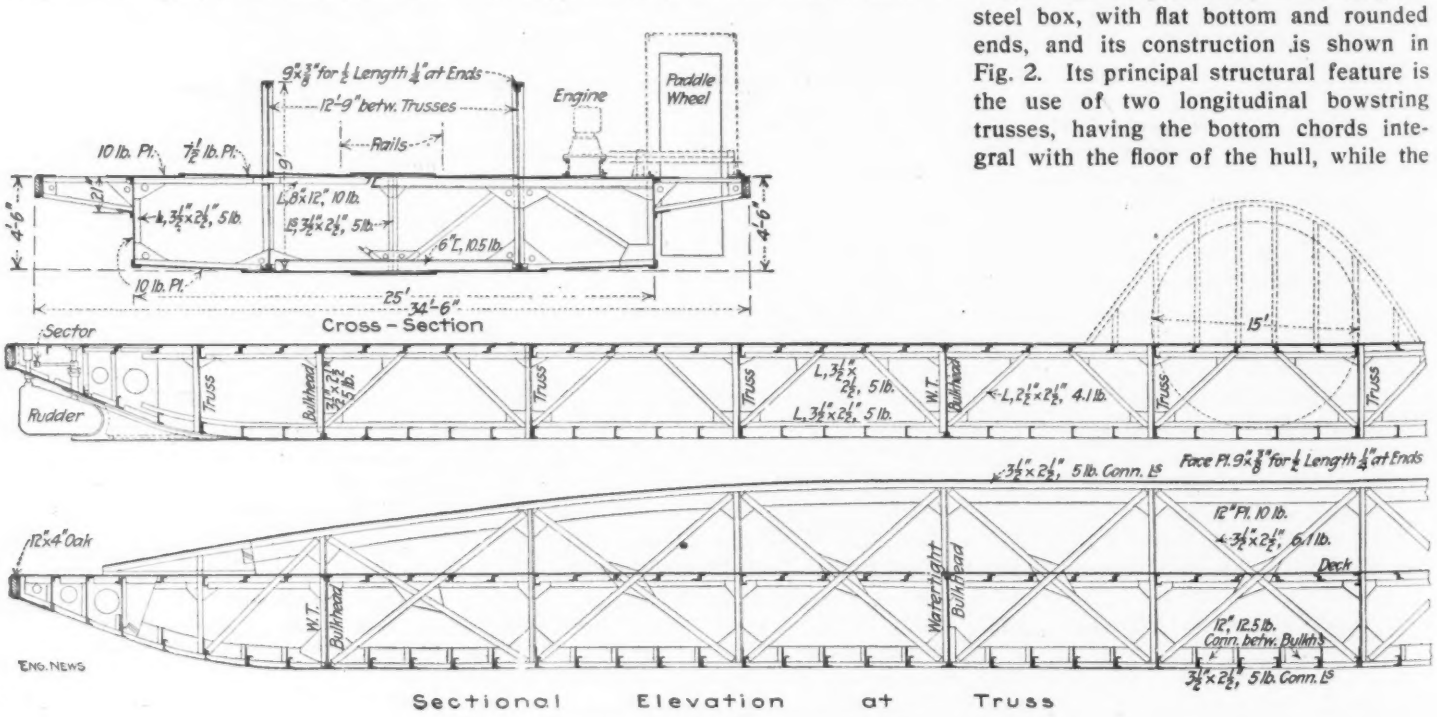


FIG. 2. TRUSSED STEEL HULL OF CAR-TRANSFER BOAT

curved upper chords rise above the deck. This construction was rendered necessary to give sufficient longitudinal stiffness to the shallow hull. Additional stiffness is provided also by longitudinal trussing in each side. There are eight transverse trusses in the hull, supporting the wood track stringers; and four watertight transverse bulkheads divide the hull into five compartments, which are entered only by manholes in the deck. These compartments are so designed that the hull will float and carry its load with any one compartment flooded. The trusses have a depth of 9 ft. and are spaced 12 ft. 9 in. apart. The chords are composed of two angles, a 12-in. plate and a 9-in. cover-plate. The posts and diagonals are angles 3½x2½ in. The floor beams are channels, and the deck beams are double angles forming Z-bar shapes. The frames are spaced 24 in. apart, or closer at the ends of the hull.

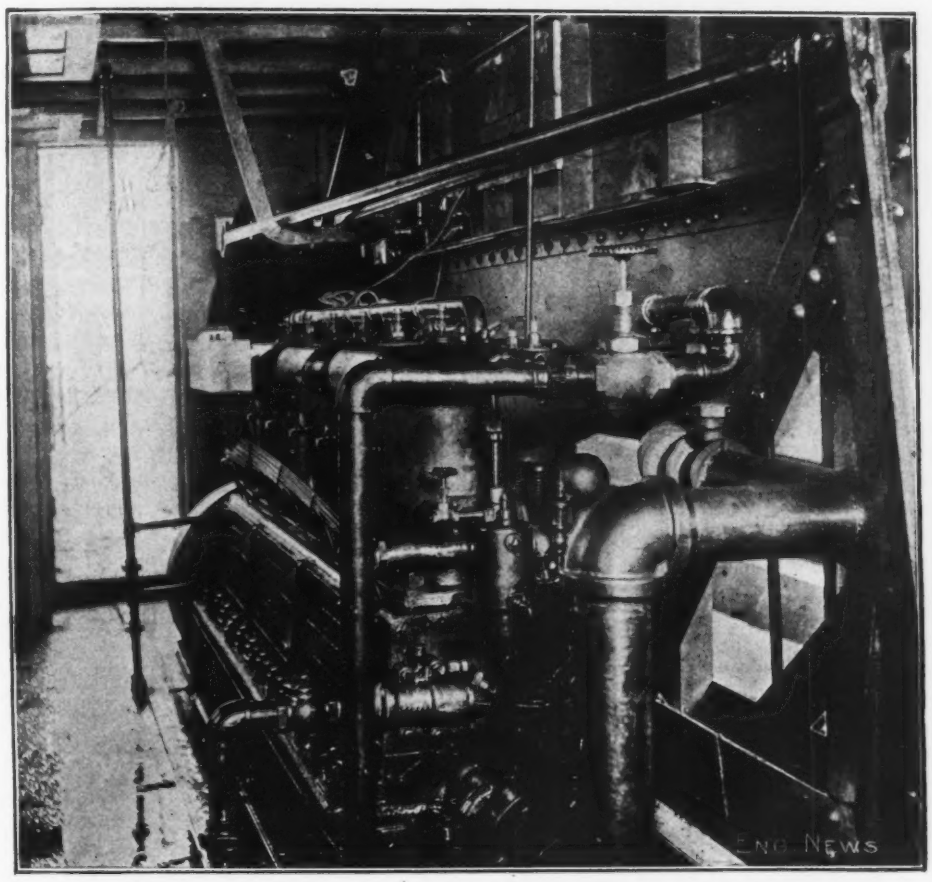


FIG. 4. ONE OF THE 54-HP. GASOLINE ENGINES OF THE CAR-TRANSFER BOAT

MACHINERY EQUIPMENT

The boat is propelled by a pair of side wheels, 15 ft. diameter, and each wheel shaft is driven independently by a four-stroke-cycle vertical gasoline engine, with intermediate gearing. Each engine is of 54 hp., having six cylinders 7x9 in. and running normally at 400 r.p.m. The engine is placed with its crank-shaft in a longitudinal direction, and as first arranged this shaft was connected to another shaft carrying two bevel pinions (with clutches), one or other of which was engaged with a bevel pinion on the paddle shaft. This is shown by the upper drawing in Fig. 3. With this first arrangement the wheels were 10 ft. diameter, each having ten buckets 36x21 in., and these were designed to have a speed of 40 r.p.m. The speed proved too high for wheels of such diameter, however, as the slip was abnormal above 25 r.p.m., and the speed of the boat was about the same at the lower as at the higher rate of revolutions of the wheels This speed was about 6½ m.p.h. in dead water. The new wheels are 15 ft. diameter and run normally at 25 r.p.m., giving a speed of 9 to 10 m.p.h. The engine speed is 400 r.p.m., as before, but the gearing has been somewhat changed, as shown by the lower drawings in Fig. 3. The outer end of the shaft which formerly carried both gear wheel and paddle is cut off, as shown, and the new paddle shaft is 2½ ft. above it, with a silent chain-drive connection between the two shafts. The speed ratio of these two shafts is 8 to 5. In case of accident to one engine, an intermediate shaft can be fitted between the two gears, to enable the other engine to drive both wheels. For this reason the gear wheels are combined bevel gears (for the main drive) and spur gears (for the emergency drive).

Each engine operates a circulating and air pump. A centrifugal combined bilge and fire pump is driven from one engine by a chain-drive and has a capacity of 250 gal. per min. This can be connected to any one of the hull compartments and deliver the water overboard, or it can take water from the river and deliver it through two hose lines to 1¼-in. fire nozzles, with 100 lb. pressure at the nozzle. A 550-volt dynamo driven by a two-cylinder gasoline engine provides current for lighting the boat and the cars, and for a searchlight on the pilot house, which is used to facilitate making the landings at night. Fig. 4 is a view of one of the engines, to the right of which is the top chord of one of the main trusses.

TRACK AND SHORE CONNECTIONS

The connections between the boat and the incline track of the shore approach is effected by a movable section of track on a cradle which is mounted on wheels and can be run up and down the incline according to the varying level of the river. A single track is laid along the center of the boat, the rails being spiked to longitudinal yellow-pine stringers, which are supported by the transverse trusses in the hull. At each end of the track is an inside guard rail, brought to a point between the track rails. In the middle of the deck at each end of the

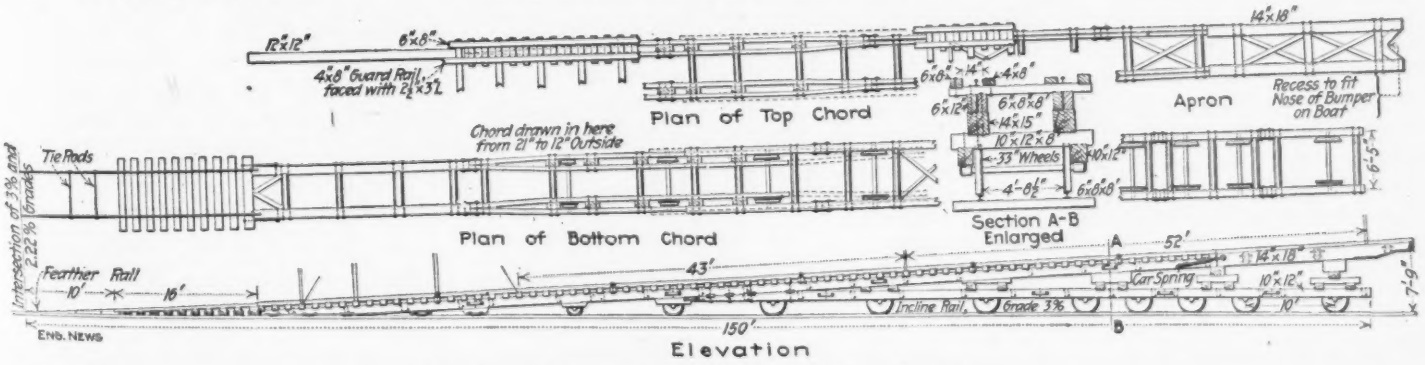


FIG. 5. CONSTRUCTION OF CAR-TRANSFER CRADLE

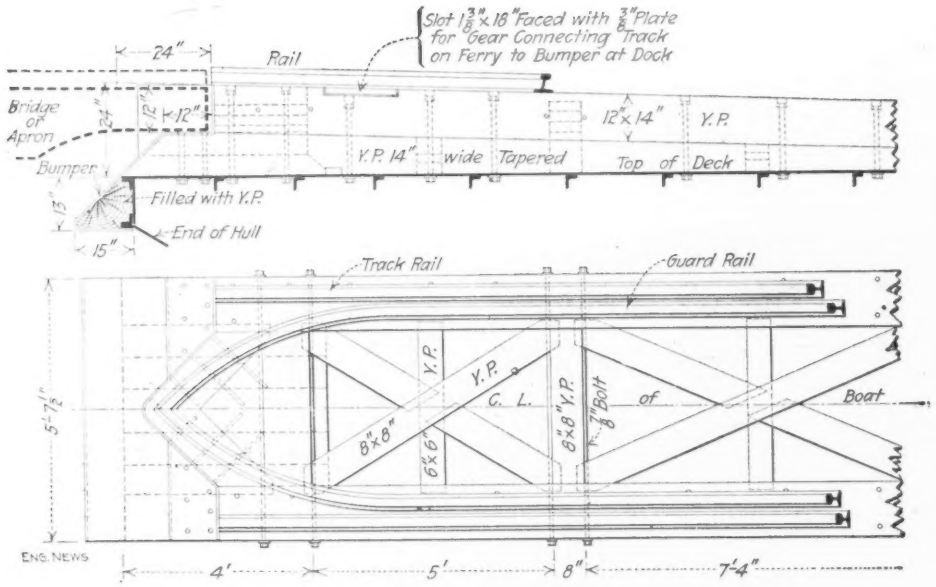


FIG. 6. BUMPER AND TRACK CONNECTION AT END OF BOAT

boat, is a projecting nose or bumper which is V-shaped in plan and fits a corresponding recess in the landing cradle, so as to hold the boat and shore tracks in proper alignment. The face of the bumper has a slope of 45°, faced with metal as shown in Fig. 6, and this serves to raise the bridge or apron attached to the cradle on the incline. This construction is in accordance with ordinary river practice.

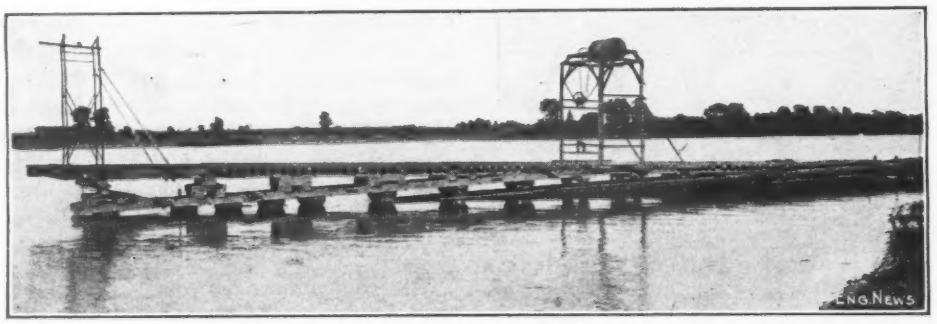


FIG. 7. CAR-TRANSFER CRADLE FOR THE EVANSVILLE & HENDERSON ELECTRIC LINE (OHIO RIVER CROSSING)

(The tower carries chain-driven drums for varying the length of the overhead wires.)

The cradle for connecting the incline track with the boat is shown in Fig. 7, and the details of its construction are shown in Fig. 5. Its total length from the feather rail (which slides on the track rail) to the outer end of the sill is 150 ft.; the track stringers project about 5 ft. further, to enable their ends to rest on the bumper of the transfer boat. The cradle is carried by ten pair of wheels and five cast-steel slides, the latter being at the inner or shore end where the height above the track rails of the incline is too small to admit of wheels. The incline has a down-grade of 3%, while the cradle track has an up-grade of 2.22%. In Fig. 7, the cradle has been pulled out of the water for the purpose of taking the photograph. In its normal position it is submerged so that only the feather rails are out of the water, the wires at the outer end of the cradle, and has a bridge or contact piece to connect with the similar contact piece carried by the pipe frame at the end of the boat. In order to vary the length of the wires according to the position of the cradle, they are wound upon 30-in. flanged drums (48-in. over the flanges), mounted on a shaft on a timber tower on the cradle, as shown in Fig. 7. One drum carries the trolley wire, and a three-flanged drum carries the other two wires. A sprocket wheel on one end of the shaft has a chain drive to a pinion on a short countershaft at one side of the tower, and a sprocket wheel on this shaft has a second chain drive to a pinion on a crank-handle shaft at convenient height for the operator.

distance from the surface of the water to the upper end of the cradle being then about 2½ ft.

The cars run on and off the boat with their own power, the trolley wires being carried by pipe poles placed 150 ft. apart along the incline, so that they can be taken down as the river rises and the cradle is pulled up the incline. A light tower or frame of pipe construction supports the trolley wire and two telephone

The Use of Oil as Fuel

BY A. O. KRIEGER*

The latest market move of the Standard Oil Co. in temporarily ceasing to contract to sell fuel oil is only an indication of one of the most momentous changes going on in the relative conditions for the different fuels available for the needs of mankind. To ascribe the position of this concern in this move to sinister motives, will not give the student of business conditions an explanation that will stand scrutiny.

The oil market has been re-adjusting itself during the last ten or twelve years to radically new conditions, brought about by great engineering improvements in the application of fuel. Up to that period, crude petroleum was looked upon simply as the raw material for the production of lighting and lubricating oils. The invention and perfection of the gasoline engine, the introduction of motor boats and automobiles, dating back to the first high-speed gasoline engine opened an entirely new market for the lighter oils, gasoline and naphtha. This developed within the short period of ten years into larger proportions than even the most optimistic oil men ever dreamed of. The inexorable law of supply and demand brought about a price level for these light oils far in excess of former values.

Before that period, the oil producer and refiner looked upon kerosene and lubricating oil as the main source of his profit; he now makes his biggest profit out of the gasoline, the first product of distillation. Kerosene and the heavy oils are brought back more to the column of byproducts. Up to a few years ago fuel oil, which is the residuum of all successive stages of distillation, was in superabundant supply, and the power user who could be persuaded to use it for steam-raising purposes as a substitute for coal, could buy at a price which compared favorably with that of coal. The user of fuel oil under boilers, primarily attracted by these considerations of economy, began to appreciate the general advantages of oil fuel—the cleanliness of the fire, the saving in labor owing to the facility with which oil can be supplied to the boilers, the absence of ashes, soot and smoke.

The oil man first attracted the engineer by offering him his waste product (fuel oil) at a lower price than coal could be bought for. Since then the consumer has become attached and accustomed to the use of oil to such an extent that he is willing to close his eye to an advance in prices and is willing to pay for the features of cleanliness and calities this advance in prices has convenience of oil burning. In some lo-

*Tachella & Krieger, 916 Victoria Bldg., St. Louis, Mo.

reached a point where these features incidental to oil fuel are not any more of sufficient inducement to pay the difference between oil and coal cost; again the law of supply and demand is asserting itself and the oil man loses customers who go back to coal fuel.

Later than his brother on land, the marine engineer adapted oil fuel to his steam-engine boilers. This delay was occasioned by the more exacting requirements as to reliability of the mechanical system of oil burning on vessels than for stationery purposes, and only after the engineering art had brought oil burning to a state of perfection was it introduced for marine purposes. Engineering considerations predominate on board ship over pure considerations of economy of fuel. When, however, oil burning could be considered fairly reliable, the great factors of cleanliness and saving in labor joined and supported the additional important features of convenient fuel storage and smaller weight. These factors are now recognized to be of such importance, from an engineering standpoint, that consideration of comparative fuel economy is forced into secondary importance and an increased price of oil fuel will be justified within liberal limits.

Oil fuel was adopted at an early stage for all smelting and metallurgical purposes, the governing considerations being the higher calorific value of oil compared with coal and coke and, with the advent of fairly successful burners, the ease with which oil fire can be controlled and regulated. These factors are weighty enough in the smelting, glass-making and metal-treating processes to warrant the manufacturer to hold to oil fuel as long as the price does not become prohibitive so as to suggest the introduction of coal again in the refined form of coal-gas. Where natural gas is obtainable, it is today being used for the above indicated purposes, but as every supply of natural gas is of limited duration, it will be succeeded by oil fuel as long as this can be procured at a price not exceeding the price at which manufactured gas in the respective locality can be made. In localities where coal is exceptionally cheap, manufacturers are even now installing gas producers to replace their oil-burning apparatus.

The introduction and perfection of internal combustion engines using crude or fuel oil, added another form of application of fuel oil. In or near the oil fields, this type of engine has been introduced for stationary power purposes to some extent, but the aggregate consumption of fuel oil in this form is at the present time of relatively small importance. When the American engines of this type reach the mechanical perfection which has been achieved in Europe during the last five or six years, they will be used more extensively in this country. Marine engineers will quickly appreciate the advantages of oil fuel when combined with the surpassing fuel economy of the Diesel engine. While these indications point toward an extensive introduction of this type of engine for propelling vessels, it appears plausible that, for stationary purposes, comparative prices of fuel will be a factor carrying considerable weight with the engineer when considering the installation of power. While, at the present time fuel oil appears still economical with internal combustion engines, a further rise may tend to retard the application of these engines for stationary power.

Inventive and engineering skill had, up to a short time ago, not been successful in finding suitable mechanical means to apply oil fuel to universal use in heating houses and the smaller industrial heating plants. The United States Patent Office has issued during the last ten years more than a hundred patents on oil burners for domestic heating purposes. The development of the next few years will show whether or not any of these devices will meet the enormous demand which is awaiting suitable mechanical means for the application of oil fuel to domestic heating purposes.

The advantages of cleanliness, absence of smoke, soot and ashes, improvement in sanitary conditions, automatic supply of fuel to the furnace and automatic operation of the burner, are considerations in domestic heating purposes which will make comparative cost of secondary importance. At prevailing prices fuel oil compares even today in most localities in the United States favorably with coal prices; in or near the oil fields domestic oil burning seems almost an economic necessity. With the general introduction of domestic oil-burning apparatus, there will be, however, good grounds for a further appreciation in the value of fuel oil. But the introduction of domestic oil-heating apparatus would not be halted by a further increase in the price of fuel oil, if it should come.

The above deductions have been made mainly from the standpoint of the fuel-oil market; it may be of interest to speculate on future developments of all fuel prices. In doing so, the writer will ignore the monopolistic tendencies of any particular concern engaged in either the oil, gas or coal trades, as he believes that while such tendencies may temporarily affect market manipulations, the final decision as to market values rests in the fundamental economic relations between consumer and producer, and that all values eventually find a natural level.

The production of crude oil, during the last twenty years, has been at such a tremendously ever-increasing rate and so stimulated by advancing prices for all grades of oils, that it may be safely assumed that the American output will continue to increase. The rising prices have laid the foundations for new oil-fuel developments such as have never been witnessed before. A yearly production of 300,000,000 bbl. in the United States is probably being approached faster than even oil men generally believe. On the other hand, engineering perfections for the employment of oil fuel are brought out at a rate with which it will be difficult to keep pace by even the largest imaginable increase in oil production. Under these circumstances, price of fuel oil will be the only factor to force retrenchment in one or the other of the channels which engineering skill has opened up to oil fuel.

It seems certain that stationary industrial steam-power plants will be the first to abandon oil, because cost of fuel is of prime importance for the power user. If he has to pay excessively for the intrinsic advantages of oil burning he will feel compelled to look for a substitute which, if not wholly, will partly embody the features of cleanliness and near-automatic handling. It is probable that artificial gas, for which gas producers have been brought to a reliable state of perfection, will take the place of oil in many industrial plants in this country; eventually coal will be used mostly in the refined form of gas, especially since the byproducts of gas-making, such as tars, tar-oils and various chemicals will tend to offset high fuel costs. The demand then will hold prices at the present or higher levels.

For portable, transportation and marine equipment, oil fuel probably will not only retain the place which it has gained, but will find ever-increasing application until it becomes the dominating fuel for these purposes.

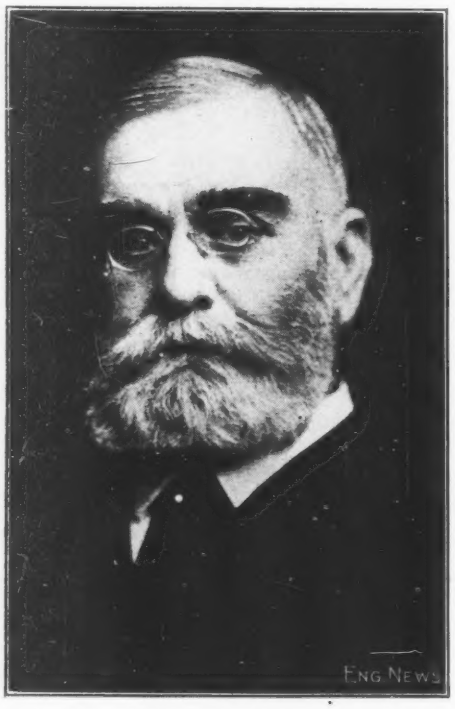
For metallurgical and similar heating processes, oil fuel when becoming excessively high in price can conveniently be replaced by gas. An engineering evolution of this kind is, however, far more remote than with stationary power plants and will take place only in such plants as are large enough to warrant the installation of their own gas plant. The smaller plants will probably forever be retained as users of oil fuel.

Oil burning for domestic heating purposes is still in its infancy, but this is solely due to the engineering difficulties. When the wasteful, clumsy and unsanitary methods of coal-burning are taken into consideration, it is to be wondered that relief had not been before this brought to the householder. The writer believes that the time is near when oil fuel will be considered as much a domestic commodity as gas and when oil will be supplied to dwellings as universally and in as convenient form. It must be apparent that under these circumstances this field of application will exert a strong tendency to uphold the prices of fuel oil.

All values may be compared with other natural forces, in that they will seek the point of least resistance. No artificial means, such as trade agreements, tariffs and monopolies will be able to offer but a temporary obstacle to this great leveling process.

Two Civil Engineer Presidents of the Pennsylvania R.R.

The resignation of James McCrea, to take effect on Jan. 1, and the election of Samuel Rea to succeed him as President of the Pennsylvania R.R. Co. again brings attention to the success of members of the engineering profession as railway executives. The late Alexander J. Cassatt, whom Mr. McCrea succeeded as President in 1907, Geo. B. Roberts, Mr. Cassatt's predecessor, Mr. McCrea himself, and Mr. Rea, all began their railway careers at the lowest round of



JAMES MCCREA

the ladder in the engineering department, and each followed engineering work for several years; Mr. Rea, indeed, has carried large responsibilities for engineering work throughout his career, and to his engineering ability is due in a large measure the success as an engineering work of the great Pennsylvania tunnel terminal and collateral works at New York City.

SAMUEL REA

Samuel Rea was born in Hollidaysburg, Blair County, Penn., Sept. 21, 1855. His great-grandfather, Samuel Rea, had emigrated to this country from the north of Ireland just a century before. His grandfather, John Rea, of Chambersburg, was an officer in the Revolutionary War, a member of Congress and an officer in the War of 1812. His father was James D. Rea, and he died when Samuel was but 13 years old.

At 16 years of age Samuel Rea entered the engineering department of the Pennsylvania R.R. as a rodman and chainman on the Morrison's Cove, Williamsburg and Bloomfield branches. The panic of 1873 put an end to practically all engineering work, and Mr. Rea was obliged to find other employment. For a year he served in the office of the Hollidaysburg Iron & Nail Co. In 1875 he reentered the engineering department of the Pennsylvania R.R., and was soon promoted to Assistant Engineer on the construction of the chain suspension bridge over the Monongahela River at Pittsburgh, Penn.

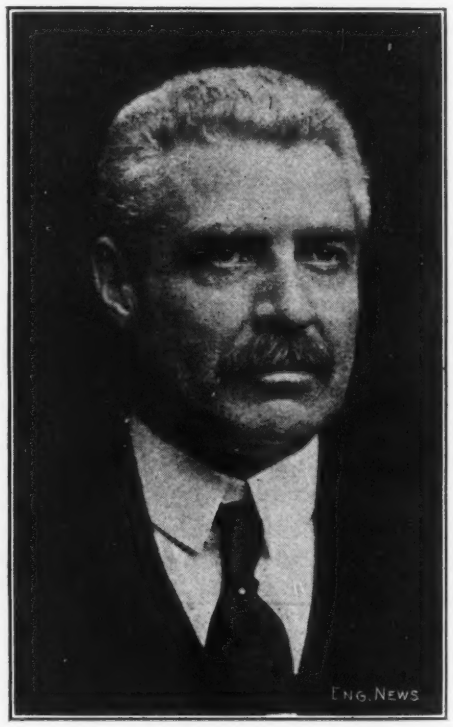
Upon the completion of this work Mr. Rea was made Assistant Engineer of the Pittsburgh & Lake Erie R.R., then in the course of construction, and he remained with this railway until its completion in 1879, when he returned to the Pennsylvania as Assistant Engineer in charge of construction of the extension of the Pittsburgh, Virginia & Charleston Ry. The succeeding four years he was Engineer in charge of surveys in Westmoreland County and of the reconstruction of the Western Pennsylvania R.R. to make it a low-grade freight line, work which was under the general direction of J. N. Du Barry, then Assistant to the President, and afterward Vice-President of the Pennsylvania R.R.

In 1883 Mr. Rea was transferred to Philadelphia as Assistant to Vice-President Du Barry, with the title of Principal Assistant Engineer. In 1888 and 1889 he was Assistant to the Second Vice-President and then resigned to go to Baltimore as the Vice-President of the Maryland Central Ry. Ill health compelled him to relinquish this office in 1891, and for a year he was obliged to abandon all active work and recuperate. In May, 1892, after an absence of three years, he returned to the Pennsylvania R.R. as Assistant to the President.

On the day of his appointment he left for London, England, where, by direction of President Roberts, of the Pennsylvania R.R., he made an examination of the railways terminating in that city and of the underground railways, then constructed and proposed. Subsequently he made a special and very valuable report on the results of his investigations, which was published in book form, and the experience thus gained was afterward put to good service in the design and construction of the New York City extension of the Pennsylvania R.R.

In February, 1897, Mr. Rea was appointed First Assistant to the President, and two years later, following the election to the presidency of the late Alexander J. Cassatt, he was elected Fourth Vice-President. From this office he was steadily advanced to that of First Vice-President in 1911. He is also Vice-President of the Northern Central Ry., the Philadelphia, Baltimore & Washington R.R., the West Jersey & Seashore R.R. and a director of the Pennsylvania R.R. and of many other railroad and financial corporations.

Mr. Rea has throughout his service with the Pennsylvania R.R. been particularly interested in the promotion and construction of new lines and branches. For many years he was much interested in the project to construct a bridge across the Hudson River at New York City, and was one of the incorporators of the North River Bridge Co., chartered by act of Congress. When the other railways terminating in New Jersey failed to join in the project for a bridge over the Hudson, the Pennsylvania R.R. decided, after a careful examination and report on the project, to build the tunnels under the Hudson and East Rivers, which



SAMUEL REA

are now familiar to engineers throughout the world. Of this work Mr. Rea was in direct charge both as executive and engineer, and for its successful completion great credit is due to him. A part of this same project is the New York Connecting R.R., which has begun the construction of a huge steel-arch bridge over the East River at Hell Gate, and of this work Mr. Rea is also the executive engineering head.

In recognition of his engineering achievements in the construction of the Hudson and East River tunnels and the New York City terminal of the Pennsylvania R.R., the University of Pennsylvania on Feb. 22, 1910, conferred upon Mr. Rea the degree of Doctor of Science.

Mr. Rea is a member of the Institution of Civil Engineers of Great Britain and

of the American Society of Civil Engineers. He is the author of "The Railways Terminating in London," a comprehensive study based on a laborious personal investigation of the physical and financial conditions of the English railway systems.

JAMES MCCREA

The first American ancestor of James McCrea was an Irish emigrant, who came to America in 1776 from Londonderry as a representative of large banking interests. James McCrea was the son of a Philadelphia physician and was born in 1848. His early education was received at a private school and his engineering studies were obtained at the Pennsylvania Polytechnic College in Philadelphia.

His railway service began in June, 1865, as a rodman, and shortly after, Assistant Engineer of the Connellsville & Southern Pennsylvania R.R. Two years later he was a rodman on the construction of the Wilmington & Reading R.R., and in 1868 he was engaged as Assistant Engineer on the Allegheny Valley R.R., where he remained for nearly three years. On Mar. 1, 1871, Mr. McCrea first entered the service of the Pennsylvania R.R. as Principal Assistant Engineer in the construction department, and from that time he advanced steadily.

In 1874 he was made Assistant Engineer of Maintenance-of-Way of the Philadelphia division. From this position he was transferred in less than a year to the operating department as Superintendent of the Middle division, and in 1878 to the important position of Superintendent of the New York division. In 1882 he began a long connection with the Western lines of the Pennsylvania R.R. System as Manager of the Southwest system, with headquarters at Columbus, Ohio. A year later he was advanced to the office of General Manager of all the lines west of Pittsburgh, and in 1887 to the office of Fourth Vice-President. From this office he steadily advanced until his election as First Vice-President in 1891.

For 16 years, as First Vice-President, Mr. McCrea had supervision of all the problems of transportation, engineering, finance and traffic, the solution of which was represented in the marked development of the lines west of Pittsburgh.

While residing in Pittsburgh, Mr. McCrea was elected, in 1898, a trustee of the University of Pennsylvania, being the first trustee ever elected who resided outside of the city of Philadelphia. Mr. McCrea resigned his office as trustee in 1903, because of his inability to attend the meetings of the board as regularly as he deemed necessary.

Mr. McCrea was elected a director of the Pennsylvania R.R. in 1899, and following the death of President A. J. Cassatt he was elected President of the company on Jan. 2, 1907, and shortly afterward of the various subsidiary railway companies.

In his letter of resignation, Mr. McCrea states that he is retiring to enjoy a rest. It is a rest well earned by almost half a century of active service, nearly 42 years of which have been spent continuously in the service of the Pennsylvania R.R.

Some Objectionable Features of Government Contracts

Speaking on this subject before the American Society of Engineering Contractors, at New York City, on Nov. 14, William B. King, of the Court of Claims bar, Washington, D. C., laid stress on four points considered essential to a just and equitable contract. In the first place the contract should be clear and definite in every respect so that both parties to it can be absolutely certain of the exact extent of their obligations under it. The second essential is provision for the assumption of full responsibility by each party for any damage to the other party, due to failure of the first party in any of his obligations under the contract. Thirdly, in such cases as frequently occur where there arises difference of opinion, impossible to foresee and mention in the terms of the contract, some fair method of adjusting such difference before a disinterested and unbiased referee should be provided in the contract. Finally, the contract should embody in letter and spirit the idea of providing full justice to both of the contracting parties.

Contracts made in good faith between private individuals or companies are apt to strive for justice in the above matters, but the progress in contracts between individuals and the government departments has been in the opposite direction. Numerous cases where disputes about contract terms have been decided against the government and in favor of the contractor have been met by changes in the terms of later contracts, limiting the contractor's rights in these points. At the present time, according to Mr. King's statement, the usual form of government contract is unfair to the contractor in the following four points: (1) the refusal of the government to guarantee physical conditions in connection with the contract work; (2) the removal, by contract terms, of the contractor's right to recompense for losses incurred through failure of the government to fulfill its obligations under the contract; (3) the placing of excessive discretionary powers in the hands of government officials; and (4) the provision that, preliminary to final payment for the work, the contractor shall sign a release to the government eliminating all his rights to recompense for damages caused through failure of the government to fulfill its obligations under the contract.

The secondary evils resulting from these faults in government contracts were claimed to be harmful both to the contractor directly and to the government indirectly. The development of physical conditions different from those stated to exist, the delays caused by government failure to supply proper material promptly, the placing of absolute discretionary powers in the hands of biased government officials (often men unfamiliar with the actual conditions of the work) and, finally, the holding up of money unquestionably due to a contractor until he agrees to forego claims to money about which there is any dispute, are all matters essentially unfair to the contractor, and calculated to result in direct and extensive financial loss to him. The burden that these things place on the government, while less direct, is equally certain; for contractors, realizing that they are assuming extra risks, make allowance for it in their bids so that the government usually has to pay more for the same work than a private individual or company would have to pay.

The reasons assigned by Mr. King for these unfair provisions in government contracts were threefold. The lack of proper information by government officials as to the conditions of the work, combined with the necessity for self-protection in case of investigations by higher officials, was the first of these reasons. General distrust of the integrity of contractors was the second reason given. And the third reason stated was the fact that government officials generally feel it their duty to serve the government's interests to the full extent of their powers and without regard for the equity in any dispute between government and contractor.

DISCUSSION

W. L. Bowman stated that in his experience considerations of political favor have often proved to be factors in the placing of contracts and in the carrying out of government obligations after work had started or been completed. He advocated as a curative measure that all responsible contractors should combine to refuse bids on work where the contract terms are too onerous. In reply to a later statement that engineers are the best fitted to arbitrate contract disputes, he stated that if all disputes were open to discussion on points of equity, to be settled by an engineer referee, in his opinion there was no use of having any contract at all.

W. B. Bamford explained the difficulty of writing a contract so as to eliminate all points of ambiguity and so that the interests of each party will be fully cared for without interfering with the rights of the other. He urged the necessity of co-

operative effort on the part of leading engineering societies, contractors' associations, and government departments to produce general forms of specifications and contracts which will lead to better and more uniform work with less friction between contracting parties.

The assertion was made by C. A. Crane that the decision of an unbiased and competent engineer in all disputes between government and contractor would be nearer just to both parties than any court decision based on the mere legal aspects of the contract, and rendered by men lacking technical training. The proposal was made by Mr. Crane that in cases of dispute a prominent engineer familiar with the work should be appointed by the president of the leading technical society in this branch of engineering, to act as arbitrator between the two contestants.

Mr. Kuichling concurred with the opinion that the engineer is the best man to serve as referee, stating as foundation for that belief the fact that the whole training of an engineer is along lines of exactness and truth. As a measure of correction for the present abuses, he advocated a publicity campaign and reliance on the *vox populi* to remedy defective conditions.

Notes from Engineering Schools

UNIVERSITY OF MAINE—The University Employment Bureau (of the College of Technology) is planning to establish branches in the larger cities of the country. The organization of these will be affiliated with the various local alumni associations.

COLUMBIA UNIVERSITY—The following non-resident lecturers on Highway Engineering have been appointed in the Department of Civil Engineering for the 1912-1913 session: John A. Bensel, State Engineer of New York; William H. Connell, Chief of the Bureau of Highways and Street Cleaning, Philadelphia; Morris L. Cooke, Director of the Department of Public Works, Philadelphia; C. A. Crane, Secretary of the General Contractors Association; W. W. Crosby, Chief Engineer of the Maryland Geological Survey and Consulting Engineer, Baltimore; Charles H. Davis, President of the National Highways Association; A. W. Dow, Consulting Chemical and Paving Engineer of the United Gas Improvement Co.; John M. Goodell, Editor-in-Chief of the Engineering Record; D. L. Hough, President of the United Engineering and Contracting Co.; Arthur N. Johnson, State Highway Engineer of Illinois; Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment of New York City; J. C. Nagle, Professor of Civil Engineering and Dean of the School of Engineering in the Agricultural and Mechanical College of Texas; Harold Parker, First Vice-President of the Hassam Paving Co.; H. B. Pullar, Assistant Manager and Chief Chemist of the American Asphaltum & Rubber Co.; J. M. F. de Pulligny, Ingenieur-en-Chef des Ponts et Chaussees et Directeur Mission Francaise d'Ingenieurs aux Etats-Unis; John R. Rablin, Chief Engineer of the Massachusetts Metropolitan Park Commission; Clifford Richardson, Consulting Engineer, New York City; Philip P. Sharples, Chief Chemist of the Barrett Manufacturing Co.; Francis P. Smith, Consulting Chemical and Paving Engineer, New York City; Albert Sommer, Consulting Chemist, Philadelphia; George W. Tillson, Consulting Engineer to the President of the Borough of Brooklyn.

The Failure of Ohio River Dam No. 26, described in Engineering News, Aug. 22, 1912, p. 366, is to be investigated by a special board of U. S. Army Engineer officers.

Gas from a Stalled Locomotive in the Northern Pacific Ry. tunnel, near Ellensburg, Wash., caused the death of one of the train crew and injury to a number of others, on Nov. 6.

Fire Prevention Day in Massachusetts was observed on Nov. 9, the 40th anniversary of the big Boston fire, which did damage amounting to $60,000,000 in the business section of Boston in 1872.

Panama Canal Excavation during October totaled 2,584,823 cu.yd., a daily average of 95,734 cu.yd. for each of the 27 working days. The rainfall for the month was 14.01 in. During October the amount of concrete laid was 66,754 cu.yd. and 332,531 cu.yd. of fill was placed in dams.

A Ton of Dynamite Exploded at the plant of the Aetna Powder Co., Aetna, Ind., on Nov. 12, and caused the death of six employees and the destruction of the pack house. Windows were broken at Miller, a mile away, by the force of the explosion, but an interurban trolley car, passing a few hundred yards from the plant, was uninjured. The cause of the accident is unknown.

The Arlington Wireless Station was stated in our issue of Nov. 7 to have cost $1,000,000, but we are in receipt of later advices to the effect that $250,000 is the correct statement of the cost of this plant, and that the larger sum was the amount appropriated for starting the construction of a system of large stations, at the following points: Panama Canal Zone; California; Hawaii; Samoa, Guam, and the Philippine Islands.

Earth Cave-ins Killed Three Men on Nov. 12. One of these accidents happened at Milville, N. J., where a high embankment was being undercut and fell unexpectedly on the laborers. The other fatality occurred in Brooklyn, N. Y., where a force of men were digging a deep sewer trench. In both cases there were others caught in the earth-falls, but these were rescued quickly and will recover.

The Derailment of a Passenger Train on the Cincinnati, Hamilton & Dayton R.R. near Antioch, Ill., on Aug. 25, was noted previously in this paper and attributed to what was then supposed to have been the cause, namely, a broken rail. Investigation by the chief inspectors of the Interstate Commerce Commission has since, however, revealed the fact that responsibility for the accident rests on the very poor condition of the roadbed, ties and track at the place of the derailment.

Another Train Derailment occurred on Nov. 16, on the New York, New Haven & Hartford R.R., when the Merchants' Limited Express left the track at Green's Farms, Conn., close to the scene of the recent Westport wreck and of the Bridgeport accident of last year. Fortunately, there was no one killed, but a dozen persons were injured. The railroad company's statement of the cause of the accident is worded as follows: "The accident was caused by something giving away under the train and dropping into a switch, which derailed the train."

Press reports state that the train was traveling at about 50 miles an hour at the time of the accident, that the derailment occurred at a switch, and that the locomotive, tender and baggage car passed the switch safely, only the last cars being derailed.

Responsibility for the Westport Accident on the New York, New Haven & Hartford R.R., on Oct. 3, is found by the coroner to rest on the dead engineman for criminal negligence; but the coroner also finds that the railway company has "concurrent responsibility" because it failed to adopt the recommendations of the coroner and the Interstate Commerce Commission following the Bridgeport accident of July 11, 1911, to put in longer crossovers. The coroner finds that short crossovers are unsafe for high speeds; that the fire extinguishers on the cars of the wrecked train were insufficient; that the track equipment was poor, but was not responsible for the wreck. The coroner recommends: larger train crews to put out fires and flag trains; the use of fire extinguishers that passengers can operate without reading directions; the use of all steel cars as speedily as is "consistent with proper construction"; the installation of approach locking devices to prevent switches being changed after a signal is given; making all trains come to a full stop before taking a crossover if it have less than a No. 20 frog; to provide automatic stops, speed controls or cab signals, and the installation of long crossovers with No. 20 frogs on the main line.

An Open Switch caused a bad accident on the Cincinnati, Hamilton & Dayton Ry. at Irvington, a suburb of Indianapolis, Ind., on Nov. 13. A passenger train, which was an hour late, was traveling at high speed trying to make up lost time, when it struck this switch and was diverted to a side track, where it collided with a heavy freight train. The railroad company places the blame on a brakeman of the freight, who they say failed to close the switch, after the freight had been sidetracked to make way for the passenger train. There were 15 killed and 45 injured among the passengers and train crew, all of the injured passengers being occupants of the smoking car and of the day coach (two wooden cars immediately back of the steel mail coach).

A 40-ft. Harbor Depth is to be secured in Cuxhaven, Germany, in order to make the harbor accessible for ships of the largest type, in particular the "Imperator" class (Hamburg-American Line).

One Hundred Seventy-five New Cars of the stepless type, described in Engineering News, Apr. 11 and Sept. 19, 1912, are to be purchased by the New York Railways. Co., of New York City, for use on its surface lines. The Public Service Commission for the First District has granted permission to issue bonds to the extent of $640,000, the proceeds of which are to be applied to the purchase of these cars. It is estimated that the cars will cost $6,000 each and the company applied for a bond issue of $1,050,000 to cover the whole cost. It was planned to retire 175 of the older-type cars now in use.

The Commission refused to allow the company to capitalize more than the difference of cost ($2,800) of the new cars over the old. This would make necessary an issue of $500,000; and the margin of $140,800 has been allowed for the discounts and expenses of sale. The amortization of the $140,800 margin is covered by theannual payment of $2,700 into a sinking fund.

The John Fritz Medal, founded in 1902 in honor of the veteran iron master whose name it bears "to commemorate notable scientific and industrial progress," has been awarded this year to Capt. Robert W. Hunt, of Chicago. Capt. Hunt was one of "John Fritz's boys." When about 20 years old he began work in the iron industry at Pottsville, Penn. Later he studied chemistry and became the chemist of the Cambria Co.

He was at various times Superintendent of steel works in Wyandotte, Mich., Johnstown, Penn., and Troy, N. Y. In 1888 he founded the firm of R. W. Hunt & Co., consulting engineers, inspectors, etc. He served in the Civil War from 1861 to 1865, rising from private to captain.

The previous awards of this medal, besides the initial presentation to Mr. Fritz, have been to Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas A. Edison, Charles T. Porter, Alfred Noble, and Sir William White.

The Panama Canal Tolls have been fixed by a proclamation of President Taft, under the authority granted by the act of Congress of Aug. 24, 1912, empowering the President to provide for the opening, maintenance, protection and operation of the canal as follows:

(1) On merchant vessels carrying passengers or cargoes, $1.20 per net vessel ton—each 100 cu.ft.—of actual earning capacity.

(2) On vessels in ballast without passengers or cargo, 40% less than the rate of tolls for vessels with passengers or cargo.

(3) Upon naval vessels other than transports, colliers, hospital ships and supply ships, 50c. per displacement ton.

(4) Upon army and navy transports, colliers, hospital ships and supply ships, $1.20 per net ton, the vessels to be measured by the same rules as are employed in determining the net tonnage of merchant vessels.

These tolls are based upon the extensive investigation and report by Prof. Emory R. Johnson, of the University of Pennsylvania. Prof. Johnson estimates that these tolls will make the canal self-supporting for the first decade, and that in succeeding decades they will yield sufficient revenue to permit the ultimate repayment of the entire $375,000,000 invested in the canal. The annual expenses for the operation and maintenance of the canal and the sanitation and government of the Canal Zone are estimated at $4,000,000. The tolls to be charged are the same as those to be charged by the Suez Canal Co. in 1913, and it is expected that tolls at Panama will have to be lowered from time to time to meet those of the Suez Canal in the future.

Personals

Mr. Thomas A. Edison, M. Am. Inst. E. E., has been elected President of the Edison companies, succeeding Mr. Frank L. Dyer, resigned.

Mr. R. Colclough, former Assistant Superintendent of the Intercolonial Ry., at Moncton, N. B., has been appointed Assistant to the General Superintendent, at Moncton.

Mr. W. D. Holliday, Assistant to the President of the Ann Arbor R.R., at Toledo, Ohio, has been appointed General Superintendent, with headquarters at Owosso, Mich.

Mr. W. D. Trump, formerly General Superintendent of the Pere Marquette R.R., has been appointed General Manager of the Detroit Terminal R.R., with office at Detroit, Mich.

Mr. C. A. Tanheiser has been appointed Engineer of Maintenance-of-Way of the Missouri, Kansas & Texas Ry., at Denison, Tex., succeeding Mr. A. A. Matthews, promoted, as noted below.

Mr. A. A. Matthews, Engineer of Maintenance-of-Way of the Missouri, Kansas & Texas Ry., at Denison, Tex., has been appointed Superintendent of the Waco division, with offices at Waco, Tex., succeeding Mr. F. S. James, resigned.

Mr. Oscar Sanne has resigned his position as structural engineer in the Bridge Department of the City of Chicago and has opened an office for private practice as a bridge and structural engineer. His office is at 1633 Monadnock Block, Chicago.

Mr. Melville E. Ingalls has resigned as Chairman of the Board of Directors of the Cleveland, Cincinnati, Chicago & St. Louis R.R., after more than 42 years of railway service, begun as President of the Indianapolis, Cincinnati & Lafayette R.R. in 1870.

Mr. Thomas J. Foley, formerly Assistant General Manager of the Illinois Central R.R., has been appointed General Manager with headquarters at Chicago, Ill. Hitherto Mr. W. L. Park has filled the offices of both Vice-President and General Manager.

Mr. Fred R. Lufkin, recently Assistant Superintendent of Lighting at Brookline, Mass., and formerly Instructor in electrical engineering at the Massachusetts Institute of Technology, has joined the staff of Mr. Walter B. Snow, Publicity Engineer, Boston, Mass.

Mr. M. H. Cahill, recently Superintendent of the Baltimore & Ohio R.R., at Newark, Ohio, has been appointed Superintendent of the Buffalo division of the Delaware, Lackawanna & Western R.R., with headquarters at Buffalo, N. Y., succeeding Mr. G. A. Poore, resigned.

Mr. Hiram J. Slifer, M. Am. Soc. C. E., whose resignation as General Manager of the Chicago Great Western Ry. was noted in our issue of Sept. 26, has opened an office as a consulting civil engineer, specializing in railway practice, at 209 South La Salle St., Chicago, Ill.

Mr. James R. Scott, Assoc. M. Am. Soc. C. E., has resigned as Bridge Engineer of the Denver City Tramway Co., and of the Denver & Northwestern Electric Ry. Co., to accept a position as Assistant Engineer with Mr. H. S. Crocker, M. Am. Soc. C. E., Consulting Engineer, Denver, Colo.

Col. William C. Gorgas, Assistant Surgeon-General of the United States Army and Chief Sanitary Officer of the Panama Canal Zone, has been awarded the Buchanan Medal of the Royal Society of Great Britain, for his achievements in the sanitation of the Isthmus. Col. Gorgas was awarded the American Medicine Gold Medal for 1912 in June last.

Messrs. Latey & Slater, Engineers, of 100 Broadway, New York City, announce the dissolution of their partnership. Mr. H. N. Latey, M. Am. Soc. C. E., has become associated with the General Electric Co., as Engineer in the railway department, New York City, and Mr. F. R. Slater, Assoc. Am. Inst. E. E., has accepted a position as General Superintendent of the Texas Power & Light Co., with headquarters at Dallas, Tex.

Mr. S. S. Morris, formerly General Superintendent of the Yazoo & Mississippi Valley R.R., at Memphis, Tenn., has been appointed Chairman of the general safety committee of the Illinois Central R.R., with headquarters at Chicago, Ill. He is succeeded at Memphis by Mr. George W. Berry, former Terminal Superintendent at Chicago. Mr. John M. O'Day, until recently Superintendent of Transportation of the Chicago & Eastern Illinois R.R., succeeds Mr. Berry at Chicago.

Mr. R. B. Fitz-Randolph, Director of the Laboratory of Hygiene of the Board of Health of the State of New Jersey, has been appointed Chief of the Division of Food, Drugs, Water and Sewerage. This division is composed of the two former divisions of food and drugs and of water and sewerage. Under the new plan the board retains as assistants to Mr. Fitz-Randolph, Messrs. F. E. Daniels, in charge of water and sewerage, and Chester G. Wigley in charge of engineering.

Mr. Charles F. Howe, Assoc. Am Inst. E. E., formerly Engineer of the Central Georgia Power Co., has resigned to engage in consulting engineering, with offices in the Georgia Life Bldg., Macon, Ga. Mr. Howe was appointed Chief Engineer of the company at its organization in 1907, and has had charge of its engineering development and of the Macon Ry. & Light Co., the Central Georgia Transmission Co., and the Flint River Power Co. He is retained by these companies as Consulting Engineer.

Obituary

Peter Lyall, head of the Canadian firm of Peter Lyall & Sons, Construction Contractor, of Montreal, Que., died on Nov. 14. He was born in Scotland in 1841 and came to Montreal in 1870.

Edward Eggleston Seelye, a civil engineering graduate of Cornell University, class of 1908, and of the Columbia University School of Mines, class of 1911, committed suicide by shooting, at his home in St. George, Staten Island, New York City, on Nov. 9. He was employed by the Oxford Copper Co., Bayonne, N. J., and was a brother of Elwyn E. Seelye, of Cornell University, class of 1904.

Engineering Societies

COMING MEETINGS

NATIONAL FOUNDERS ASSOCIATION.
Nov. 20-21. Annual convention at New York, N. Y. Secy., J. M. Taylor, 29 So. La Salle St., Chicago, Ill.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 21-22. Annual meeting at New York, N. Y. Secy., D. H. Cox, 29 W. 39th St., New York.

AMERICAN MINING CONGRESS.
Nov. 25-28. Annual convention at Spokane, Wash. Secy., J. F. Callbreath, Denver, Colo.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Dec. 2-3. Annual meeting at New York City. Secy., W. H. Ross, 154 Nassau St., New York.

NATIONAL COMMERCIAL GAS ASSOCIATION.
Dec. 2-5. Annual meeting at Atlanta, Ga. Secy., Louis Stotz, 29 W. 39th St., New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.
Dec. 3-6. Annual convention at Cincinnati, Ohio. Secy., E. L. Powers, 150 Nassau St., New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 3-6. Annual meeting at New York City. Secy., C. W. Rice, 29 W. 39th St., New York.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Dec. 4-6. Annual meeting at Detroit, Mich. Secy., J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

NATIONAL HOUSING ASSOCIATION.
Dec. 4-6. Annual conference at Philadelphia, Penn. Secy., Lawrence Vieller, 105 E. 22d St., New York.

NATIONAL SOCIETY FOR THE PROMOTION OF INDUSTRIAL EDUCATION.
Dec. 5-7. Annual convention at Philadelphia, Penn. Secy., C. A. Prosser, 105 E. 22d St., New York.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS.
Dec. 9-12. Annual meeting at New York City. Secy., Percy H. Wilson, Land Title Bldg., Philadelphia, Penn.

NATIONAL ASSOCIATION OF CEMENT USERS.
Dec. 10-14. Annual convention at Pittsburgh, Penn. Secy., E. E. Krauss, Harrison Bldg., Philadelphia, Penn.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.
Dec. 26-28. Annual meeting at Chicago, Ill. Secy., C. O. Reed, Urbana, Ill.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Dec. 30-Jan. 6. Annual meeting at Cleveland, Ohio. Secy., L. O. Howard, Smithsonian Institution, Washington, D. C.

Canadian Society of Civil Engineers—At the meeting of the Society, on Nov. 7, a paper was read on "The Protection of the Foreshore at Dallas Road, Victoria, B. C.," by G. N. Duncan, followed by discussion of "The Effect of Sea Water on Portland Cement Concrete Structures."

American Society of Civil Engineers—The program of the Nov. 20 meeting in New York contained discussion of the following papers: "The Sewickley Cantilever Bridge Over the Ohio River," by A. W. Buel; and "Ports of the Pacific," by H. M. Chittenden, and A. O. Powell.

The subject of "Properties of Timber That Make for Durability," was discussed at the meeting of the Colorado Association, at Denver, on Nov. 9.

Illuminating Engineering Society—The New York Section held a joint meeting with the New York Companies Section of the N. E. L. A. on Nov. 18, with a program including a paper by P. S. Millar on "Demonstrations of Lighting Effects," accompanied by actual demonstrations with apparatus and lamps arranged to show different lighting effects.

The paper before the New England Section at Boston, Mass., on Nov. 18, was "Laboratory Photomatry," by Mr. Keyes, of the Boston Edison Co.

On Nov. 22, Prof. H. S. Hower will address the Pittsburgh Section on "The Uses of Lenses in Illumination."

National Housing Association—At the Second National Conference on Housing to be held at Philadelphia, Penn., on Dec. 4-6, the following papers will be given: "Health Departments and Housing," by C. B. Bell; "The Best Type of Workingman's House," by John Ihlder; "Regulation by Law," by Mrs. A. F. Bacon; "Garden Cities," by Grosvenor Atterbury; "Instructive Sanitary Inspection," by Mrs. J. v. Wagner; "Financing the Small House," by T. J. Fitzmorris; "Property Divisions, Lot Depths, Height Regulation," by A. W. Crawford; "Suburban and Rural Housing," by E. S. Forbes; "Room Overcrowding and the Lodger Evil," by Lawrence Veiller; and "The Factory and the Home," by John Nolen.

American Institute of Chemical Engineers—The following papers will be read at the 5th annual meeting at Detroit, on Dec. 4-7: "Protection of Intellectual Property in Relation to Chemical Industry," by Dr. L. H. Baekeland; "Availability of Blast Furnace Slag for Making Brick," by Prof. A. E. White; "Industrial Fellowships," by Prof. R. K. Duncan; "Tests on the Opacity and Hiding Power of Pigments," by G. W. Thompson; "Composition of Glucose and Starch Sugars," by Dr. E. Gudeman; "Solvents for Acetylene," by J. H. James; "Rotary Kiln-Lining for Burning Portland Cement Clinker of Unusual Composition," by C. A. Newhall; and "The Bituminous Rocks of the United States, and Their Use for Street Surfaces," by S. F. Peckham.

Excursions to various chemical and engineering works in and near Detroit, have been arranged.

American Society of Mechanical Engineers—Plans are being completed for the joint meeting of the Society with the Verein Deutscher Ingenieure, at Leipzig, Germany, in June, 1913. A special steamer will be chartered by the Society, sailing from New York, probably on June 11, and arriving in Germany on June 21. The following three days will be spent in Leipzig in the joint meeting of the societies. After that a tour through the larger industrial centers of Germany, has been arranged, including visits to Dresden, Berlin, Düsseldorf, Bonn, Frankfort, Nürnberg, and Munich. On this trip, which will probably also include the Krupp Works, at Essen, there will be an exceptional opportunity offered for study of German methods along industrial and engineering lines. The party will leave Germany about July 7.

American Institute of Electrical Engineers—At a meeting of the Board of Directors in New York City, Nov. 8, the president was authorized to appoint a committee on the use of electricity in mines, similar in scope to the other technical committees of the Institute.

The Public Policy Committee submitted for passage certain resolutions addressed to Congress relating to the American patent situation. These were adopted, subject to the approval of a majority of the Public Policy and the Patent Committees, and urged a suspension of action on all patent bills now pending, and the appointment of a commission made up of unbiased, independent, nonpartisan men of national standing to investigate the American patent situation and to recommend to Congress such action as may appear expedient.

On recommendation of the Public Policy Committee the directors adopted a resolution stating that the Board of Directors would approve the appointment by the president of a committee or delegation to confer with a committee of Congress before which any bill is pending with reference to the engineering questions involved and when a question at issue is purely one of engineering.

A midwinter convention is to be held in New York City Feb. 26-28, 1913, under the auspices of the Standards Committee. This meeting will be devoted to the general subject of the rating and testing of electrical machinery and apparatus and members are invited to contribute for this convention papers and discussions dealing with that subject. All those desiring to contribute papers for this convention should notify the chairman of the Standards Committee (Prof. A. E. Kennelly, Harvard Univ., Cambridge, Mass.) immediately and all manuscripts must be received at Institute headquarters on or before Jan. 1, 1913.

National Association of Cement Users—The following tentative program has been announced for the annual convention to be held Dec. 10-14 at the Fort Pitt Hotel, Pittsburgh, Penn. Only papers and lectures are given here; the usual committee reports and conferences will also take place.

Dec. 10—8 p.m.—"The Use of Concrete in Irrigation Work," F. H. Newell.

Dec. 11—9 a.m.—"The Present Status of Unit Methods of Reinforced-Concrete Construction," John E. Conzelman; "Concrete Grain Elevators," R. P. Durham; Barney Weller.

Dec. 11—3 p.m.—"Methods of Design and Results of Tests on Girderless Floor Construction of Reinforced Concrete," T. L. Condron; "Test of a Reinforced-Concrete Warehouse," Arthur R. Lord, "Rigid Frames and Arches of Reinforced Concrete in Building Construction," Sanford E. Thompson.

Dec. 12—9 a.m.—"Vitrolithic Concrett Pavements," R. C. Stubbs; "The Concrete Roads of Wayne Co., Michigan," Edward N. Hines.

Dec. 12—3 p.m.—"Tests of Waterproofings for Concrete," Cloyd M. Chapman; "The Effect of Electric Current on Concrete," E. B. Rosa, Burton McCollum and O. S. Peters; "Fire Test of Cement Stucco Partitions," L. H. Miller; "Discussion on Metal Lath Construction," H. B. McMaster.

Dec. 12—7:30 p.m.—Anual Banquet.

Dec. 13—9 a.m.—"The Constitution of Portland Cement. Some Results Obtained at the Experimental Cement Plant of the Bureau of Standards," P. H. Bates; "The Progress of the Work in Cement and Concrete of the Bureau of Standards," Rudolph J. Wig.

Dec. 13—3 p.m.—"The Manufacture of Artificial Stone in Germany," Julius Carstangen; "The Coloring and Texture of Concrete Products," Adolph Schilling.

Dec. 13—8 p.m.—"The Use of Concrete by the Bureau of Yards and Docks," H. R. Staniford; "Recent Applications of Concrete and Reinforced-Concrete in the City of Pittsburgh," Norman S. Sprague; "The Application of Concrete in the Abolition of Grade Crossings," James W. Phillips; "Reinforced Concrete in Railroad Work," M. A. Long.